Environmental Assessment
Assessment of Effect

Management Ignited Prescribed Burns for 2002-2003

Big Bend National Park, Texas

Summary

Big Bend National Park proposes four prescribed fires of about 893 acres during the late summer or fall of 2002 winter and spring of 2003. The RGV Wetland-Gambusia, Comanche Draw and tamarisk pile units resource management burns are scheduled for sometime in the fall, winter or early spring of 2002-2003. The Southeast Rim Unit is scheduled to occur during the months of September or October.

This environmental assessment analyzed two alternatives with respect to their environmental impacts; the no action alternative which is to not implement the prescribed burns and proceed with current management and the preferred alternative which was to implement the prescribed burns to meet resource management objectives that differ for each unit.

The need to conduct these prescribed burns are to meet specific land management objectives, which include the reduction of dead and down woody material, reduction of brush density to facilitate an increase in total ground cover, reduction of juniper cover, reduction of exotic species and improvement of endangered species habitat. When completed, burned units would be a random mosaic of burned, unburned and mixed areas varying in size. The burn units would be treated with fire intensities ranging from low to high based on the objectives of each treatment. The immediate visual effects of the fire are expected to be noticeable for 3-5 years.

The prescribed burning would be accomplished using hand ignition. The actual implementation dates would depend on the occurrence of favorable burning conditions detailed in specific project burn plans and other mitigating factors identified in this environmental assessment (EA). The burn plan specifies optimal vegetation and weather conditions to achieve project objectives while minimizing the risk of escape. To minimize air quality impacts, atmospheric conditions favorable for smoke dispersal would also be taken into account. Prior to burning, the Air Quality Division of Texas Natural Resource Conservation Commission (TNRCC) would be consulted. The proposed action would have no impacts to cultural resources

Sensitive areas, where no burning is planned or where physical impacts would be mitigated, have been identified in each unit. Sensitive areas include Gambusia habitat, cultural sites, rare plant locations, and research areas. Fire effects would be monitored for up to 10 years to determine if objectives have been met. Measurements would be made at intervals of time designed to detect such changes (i.e. one, two, or more growing seasons).

The proposed action would have no effect on threatened, endangered or species of special concern. Impacts to cultural, archeological and historical resources would range from no effect to no adverse effect. Impacts to vegetation, wildlife, air, soil and water resources ranged from long-term minor to moderate benefits to short term minor adverse impacts.

Public Comment

If you wish to comment on the environmental assessment, you may mail comments to the name and address below. This environmental assessment will be on public review for 30 days. Please note that the names and addresses of those who comment become part of the public record. **If you wish us to withhold your name and/or address, you must state this prominently at the beginning of your comment.** We will make all submissions from organizations, businesses, and from individuals identifying themselves as representatives or officials of organizations or businesses available for public inspection in their entirety.

Please Address Comments to:

Superintendent

PO Box 129

Big Bend National Park, TX 79834

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

I Introduction

I.A Justification for Action

Big Bend National Park is located within the southern half of Brewster County in Southwest Texas at the “Big Bend” of the Rio Grande along the international boundary with Mexico. The park contains 764,608 acres Federally owned within the authorized boundary and the remainder is private lands. Big Bend is an internationally significant park, in that it is the largest representative protected area of Chihuahuan Desert in the United States. It is designated as an UNESCO Man and the Biosphere Reserve. The unique combination of topographic extremes and corresponding diversity of habitat supports a multitude of plant and animal species. Many species are found nowhere else in the United States and a few species occur nowhere else in the world. This area provides habitat and protection for a large number of plants and animals.

More information may be obtained by visiting the park’s web page (www.nps.gov/bibe/home.htm) or mailing in your request.

All National Park Service management programs must take into account policy direction provided in federal legislation, agency policy statements, and park management statements. The present Fire Management Program of Big Bend National Park complies with such policies and guidelines.

I.A.1 Legislation

The Organic Act of August 25, 1916 (39 Stat. 535) established the National Park Service and gives authority "...to conserve the scenery and the natural and historic objects and the wildlife therein..." It also authorizes the Secretary of the Interior to conduct certain management actions in national park areas.Big Bend National Park was created by the Establishment-Authorization Act (June 20, 1935, 49 Stat. 393, appended). This Act provides that "lands...as necessary for recreational park purposes...are hereby established, dedicated, and set apart as a public park for the benefit and enjoyment of the people." This act also stipulates that the provisions of the National Park Service Organic Act apply.

In 1973 a total of 533,900 acres, mostly roadless desert and mountain country, were recommended to Congress for wilderness designation, and an additional 27,000 acres were recommended as potential wilderness. The proposal was eliminated from the National Parks Omnibus Bill in the 1978 session of Congress. Even though the proposal was not acted upon by Congress, the recommended area must be managed by the National Park Service in a manner which will not destroy its future suitability for wilderness designation.

I.A.2 Departmental and Agency Guidelines

Guidelines for implementing the Fire Management Plan are contained in several National Park Service documents. These include Management Policies (2001, sec 4.0), DO-18 Wildland Fire Management Guideline (1999), NPS-77 Natural Resources Management Guideline (1991), and the Department Manual (910 DM 1).

I.A.3 Management Guides for Big Bend National Park

In addition to complying with legislative, departmental, and agency requirements, the Fire Management Program is guided by management goals set forth in existing documents such as the General Management Plan (Big Bend National Park 1981), the Statement for Management (Big Bend National Park 1992), and the Resources Management Plan (Big Bend National Park 1988). These documents, on file at Big Bend National Park, reflect specific park values that must be protected. Both the Resources Management Plan and the General Management Plan recognize objectives directly related to comprehensive fire management. Both plans identify the goal of developing environmental awareness through concepts such as ecosystem and landscape dynamics. These documents emphasize support for research directed toward interpretation and resources management, ecosystem management, biodiversity, and the preservation of the park's many scenic, geological, biological, and historical features.

The current Statement for Management recognizes the need to maintain the dynamic Chihuahuan Desert ecosystem while minimizing adverse impacts on that system; the need to identify, research, and interpret the ecological, historical, and cultural resources of the area; and, the necessity of cooperating with neighbors in the public and private sector.

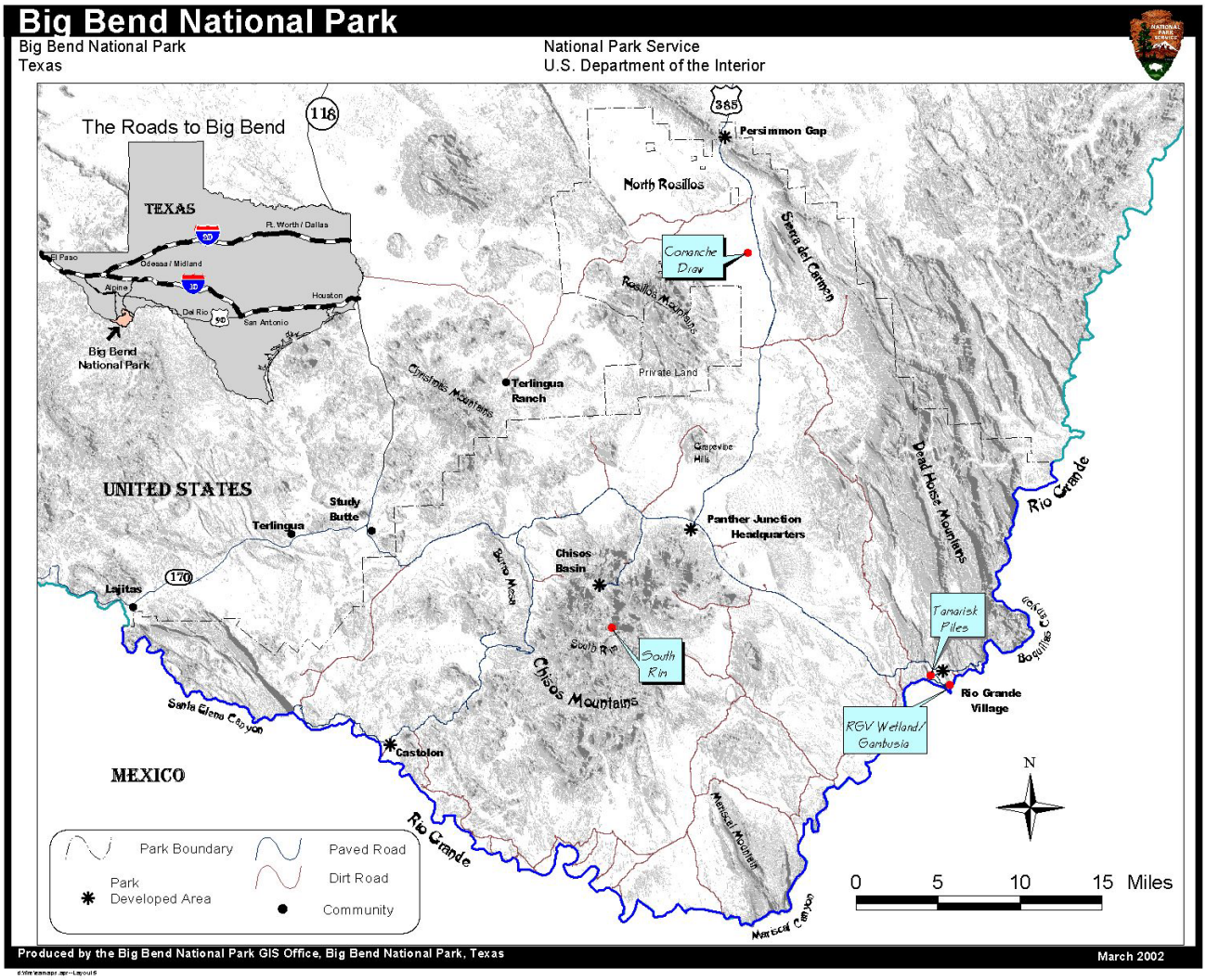

Figure 1. The location of Big Bend National Park and the proposed prescribed burns: Southeast Rim, Comanche Draw, RGV Wetlands-Gambusia and the Tamarisk Piles.

The National Park Service at Big Bend National Park preserves and protects a representative area of the Chihuahuan Desert along the Rio Grande for the benefit and enjoyment of present and future generations. The park includes rich biological and geological diversity, cultural history, recreational resources, and outstanding opportunities for bi-national protection of shared resources.

The National Park Service and the Rio Grande Wild and Scenic River preserves and protects free-flowing and natural and scenic conditions of the river and its immediate environment for the benefit and enjoyment of present and future generations.

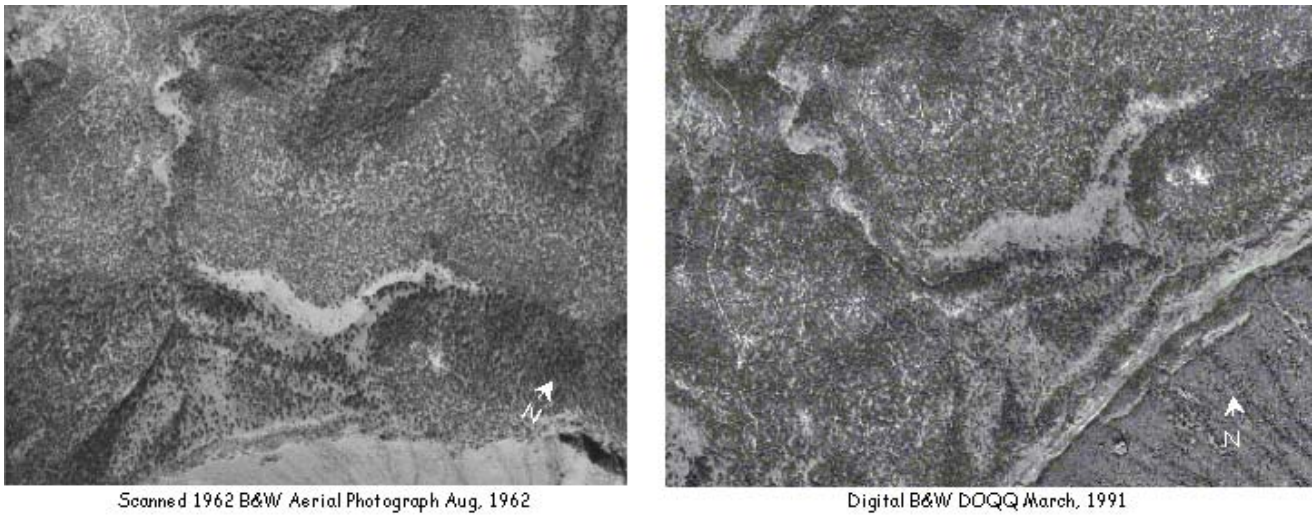

Figure 2. Black and white aerial photos of the Southeast Rim Unit taken thirty years apart indicate a closing of the woodland canopy and with it an increasing risk of a crown fire. The Southeast Rim prescribed burn is being proposed to reduce this risk and maintain the current woodland community.

I.B Need and Purpose of Federal Action

I.B.1 Need for Actions

The Southeast Rim Unit

Throughout the southwestern United States the volume of vegetation or fuel-loading in forest and woodland communities has increased above pre-European settlement levels. The primary cause for this increase has been attributed to land use; principally overgrazing by livestock and active fire suppression (Swetnam and Baisan 1996a). The benchmark year when changes began to occur is about the 1880's when the frequency of recurring fires decreased dramatically throughout the west. In the absence of these fires, vegetation has accumulated beyond a threshold were the ability to suppress and contain extreme wildland fires is being exceeded and fires are burning in ever increasing size and intensity. The these fires, occurring outside their range of natural variability are having adverse impacts on plant communities and watersheds.

Livestock grazing had a significant impact on the fire regimes within they park, perhaps as early as the late 19th century. Cattle and to some degree sheep and goats were able to impact fire regimes by significantly reducing the grass and forbs necessary to sustain fire spread. And although livestock grazing ceased in 1944 with livestock removal from Big Bend National Park, organized fire suppression had began with the Civilian Conservation Corp's (CCC) occupation in the mid-1930s. Organized fire suppression continues to the present with the Chisos Mountains presently designated as a full suppression zone of all natural and human caused fires in the current Fire Management Plan for Big Bend National Park (National Park Service 1994). Over this period fuelloads in the woodland and forest communities has not been static but have increased. A cursory analysis of aerial photography of the Chisos Mountains taken in August 1962 and again in March 1991 indicate that the forest and woodland canopy cover increasing and in some areas the canopies are closing (Figure 2). A study is now under way to more fully characterize these changes over a longer period of time. Presently fuel loads on the Southeast rim are twice that of fuel model 2, the standard fuel model for the area (Anderson 1982). The closing of the forest/woodland canopy and increasing fuel loads are increasing the risk of a large-scale extreme wildland fire that may have severe ecological and hydrological consequences.

In reconstructing the fire history of the Chisos Mountains, (Moir 1982) found that return intervals for tree-scarring fires in Boot Canyon and on the Southeast Rim were from 9 to 60 or more years, with the last recorded wide spread fire occurring about 1903. He also noted that fires may have occurred that were not recorded in the fire scar record thus introducing significant uncertainty into any estimate of a "mean fire return interval" for this area. What effects a fire return interval greater than 100 years would have on forest or woodland succession are largely unknown. That is, such extended fire free intervals would be outside the

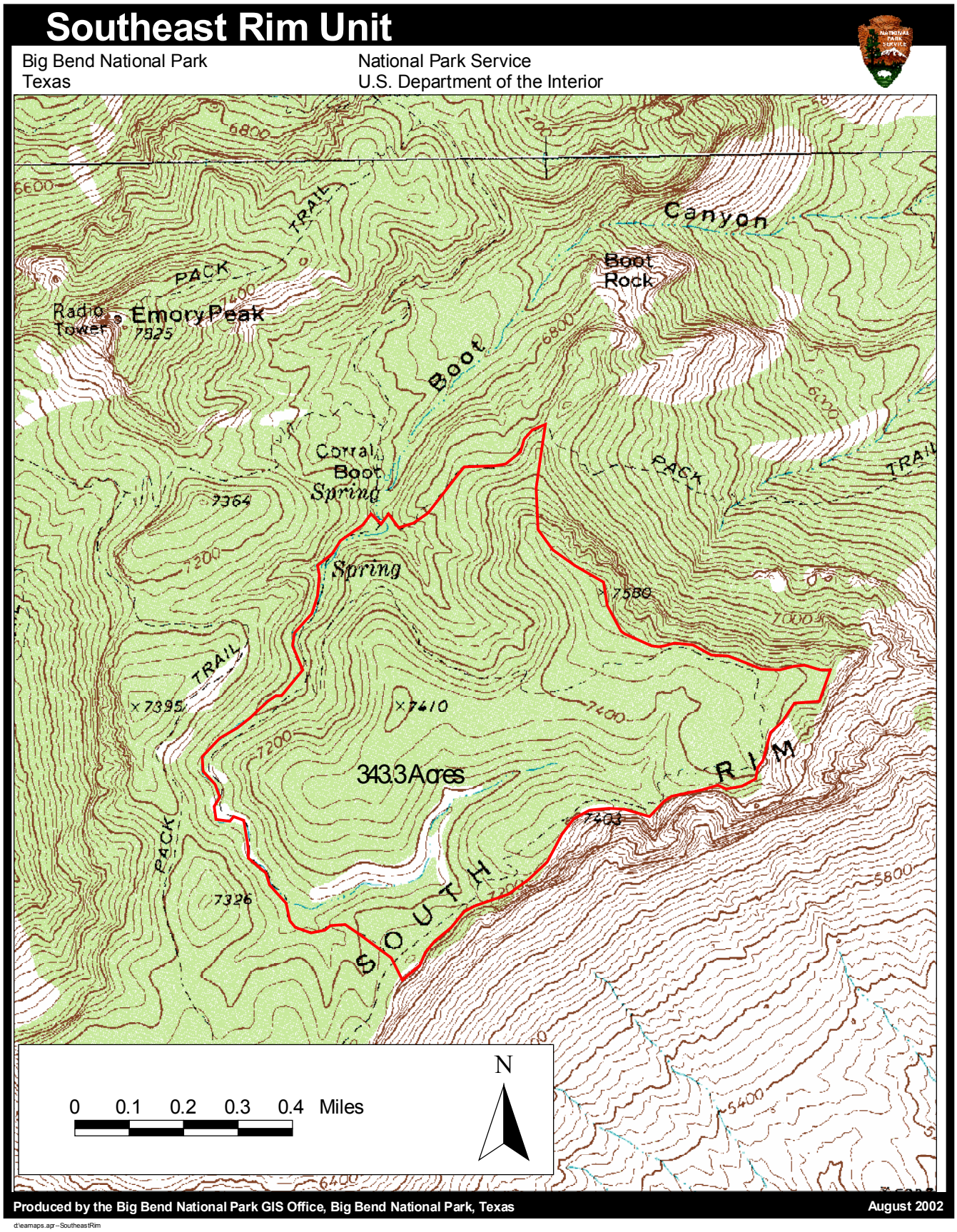

Figure 3. Map of the 343 acre Southeast Rim Unit.

range of observed natural variability. In order for the present structure of forests and woodlands to be maintained Moir suggest that a low intensity surface fire would need to occur within every fifty-year period.

Like other southwest forest and woodlands, the abundant fire-scars found throughout the Chisos suggest that historically recurrent fire has been a keystone ecological process (Swetnam and Baisan 1996b). The nature of this scarring is consistent with low intensity surface fires that consume downed and woody fuels, and a portion of low growing herbaceous vegetation and young trees. The effects of this type of fire will vary topographically as moisture conditions vary with aspect. On level terrain and on south and southwest facing slopes the woodland is open with a grassy understory and scattered shrubs. Woodlands on north facing slopes, which are more moist, have a greater tree density and a more closed tree canopy. Frequently recurring fire will maintain tree densities at low levels and minimize the accumulation of standing dead and downed woody debris. Extended fire free periods however would allow for dead and downed woody fuel to accumulate and for dense stands of young trees to develop thus creating a fuel bed that would allow a low intensity surface fire to ascending into the tree canopy and become an extreme stand replacing fire. Such an event could result in the loss of mature trees and old growth trees; trees that in times past, have persisted through numerous surface fires. Since fire chronologies indicate that the present fire free interval exceeds the longest recorded fire free period, and that the forest and woodland canopy appears to be closing, management intervention may be necessary to reduce the risk of extreme fire events. Prescribed fire is being analyzed as a means to maintain the present woodland/savanna structure for the South Rim and reduce the risk of losing old growth trees and converting the woodlands and forests to open grasslands or shrub-oak dominated communities (Figure 3). By reducing the accumulated fuel on the Southeast Rim, natural fire may be allowed in the future to resume its natural ecological function in the Chisos Mountains.

Comanche Draw Unit

Healthy desert grasslands typically experience some level of recurring fire, the frequency of which is a function of the availability of fine fuel and an ignition event such as dry lightning (lightning without wetting rain) , a common occurrence during the spring and summer months. Spatially extensive fires generally occurred in dry years immediately following years of above normal precipitation (Wright and Bailey 1982). In the absence of trees to recorded fire return intervals indirect evidence has been used to estimate mean fire frequencies that range from 7 to 10 years in desert grasslands (McPherson 1995a). Thus recurrent fire, in concert with climate variation, maintained a dynamic balance between shrubs and grasses. Thus over time, dominance between grasses and shrubs oscillated as precipitation patterns and fire frequency varied. When overgrazing by livestock became prevalent in the late 1800's, fire's role as an ecological process was diminished primarily as a result of the reduction in grass cover. In the absence of recurrent fire, shrub establishment increased dramatically, generally at the expense of grasses. And shrubs, once established and having attained sufficient size are able to preemptively use most of the soil moisture leaving little for recovery of warm season grasses, even after cattle grazing was eliminated from the park. Consequently, shrubs now persistently dominate what were once extensive desert grasslands. Where desert grasslands remain intact, however, fire may be important in their preservation particular where grassland fragmentation has restricted fire spread. The Comanche Draw burn (Figure 4) is being proposed to gain information on the effects of fire on intact patches of grasses and shrubs. Currently Big Bend National Parks fire management plan calls for this and other similar areas within the park to be managed as fire use areas. These are areas where naturally ignited fires under certain conditions fires will be allowed to burn (National Park Service 1994). This policy is in place without a fundamental understanding of wildland fire effects on these plant communities. Prior to implementing this prescribed fire, the site would be fully characterized in terms of vegetation composition and structure as well as the arrangement and composition of the fuels. Additionally the soil seedbank will be characterized both in the eroded intercanopy areas and beneath the shrubs were the soil is believed to be intact. Fire intensities would be measured during project implementation with plant response monitored several years following treatment. This information would provide guidance for fire management of these areas as well as fundamental information on the positive and negative effects of fire in these ecosystems.

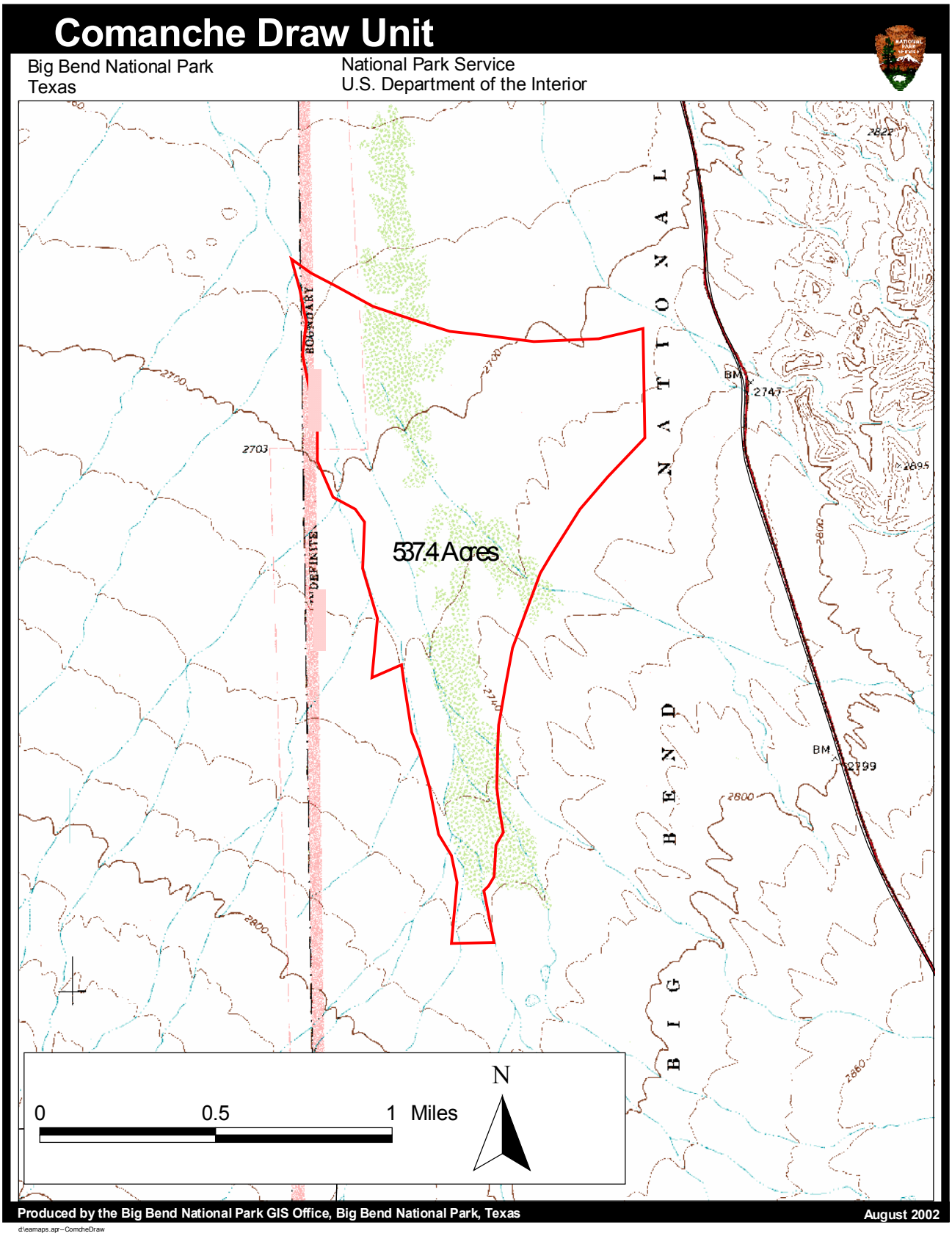

Figure 4. Map of the 537 acres Comanche Draw Unit at Big Bend National Park, TX .

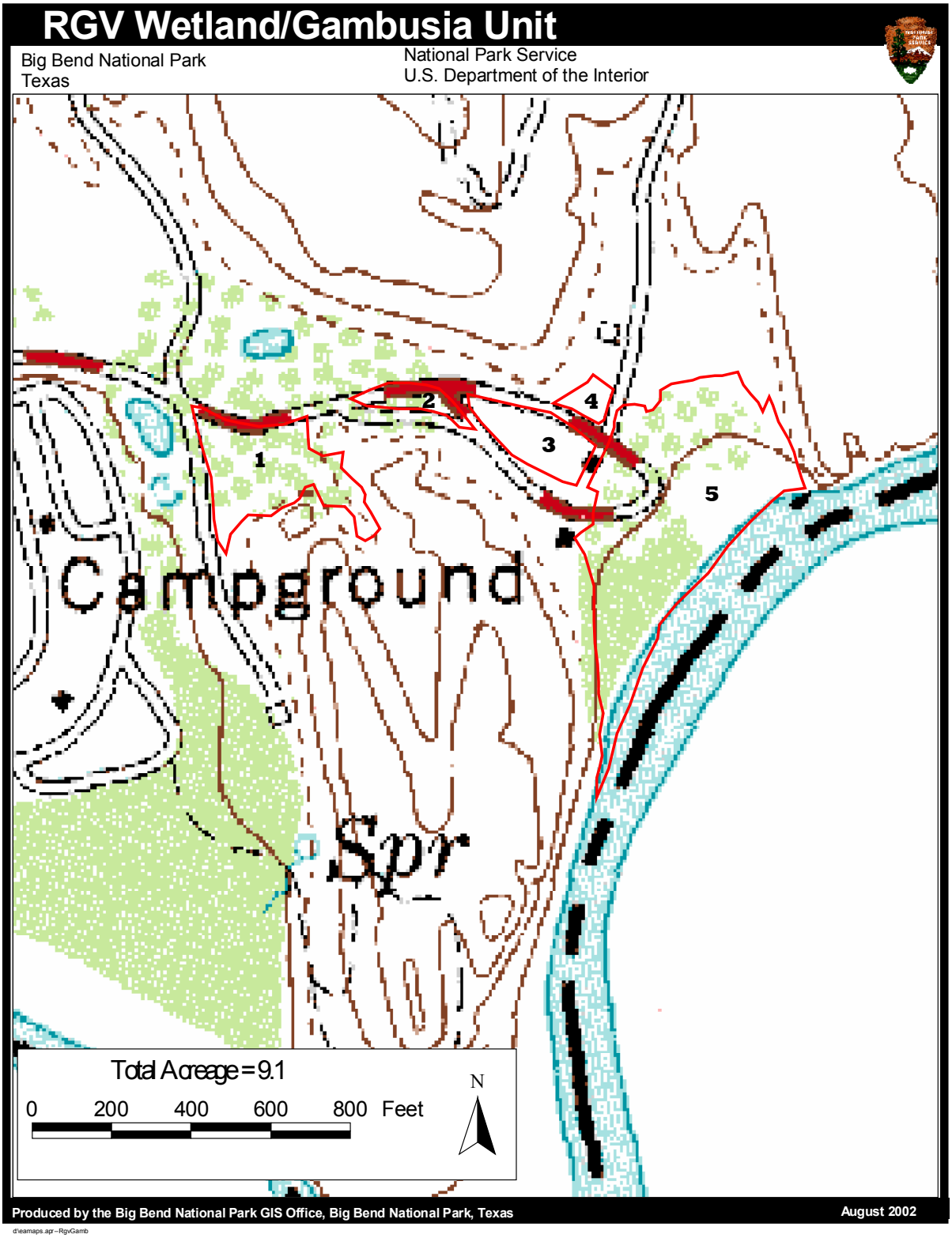

Figure 5. Map showing the location of the 9 acres RGV Wetland/Gambusia Unit at Big Bend National Park, Texas.

RGV Wetland-Gambusia Unit

Prescribed burning of RGV Wetland-Gambusia Unit (Figure 5) is being proposed to facilitate the restoration of habitat critical to the endangered fish, Rio Grande Gambusia (Gambusia gaigei). Historical land use cultivation and road development has facilitated mesquite and other shrubs to encroach (Prosopsis glandulosa) into the wetland/riparian habitat of the endangered fish. The presence of mesquite has caused hydrologic flow to diminish reducing both the spatial and temporal availability of subsurface and surface water needed to sustain the wetland and the riparian habitat. Removal of mesquite is a crucial step in restoring hydrologic flow to the site. Reducing the mesquite overstory will decrease transpiration thus providing more soil moisture to allow for the restoration of native grasses. Restoration of the site began with cutting and stacking of the mesquite wood where burning was not feasible. Prescribed fire is being proposed to complete the removal of the remaining mesquite canopy and to dispose of the woody debris created by the initial mesquite cutting. The prescribed burn will release nutrients from cut woody debris and "top-kill" the remaining mesquite within the treatment area of about 10 acres. Although fire may top-kill the above ground portion of the mesquite, the root system remains alive and will resprout and in time replace that part of the mesquite removed by the fire. Thus additional burn treatments may be necessary to suppress or kill the surviving plants and maintain the grasses that have been established.

Tamarisk Piles

The burning of tamarisk piles is a follow up treatment to exotic plant control at Rio Grande Village (Figure 6). The mechanical cutting and removal of tamarisk results in piles of woody debris which must be removed so that native vegetation is not deprived of space, and do not pose a hazard for park visitors. The piles would also detract from the Boquillas Valley cultural landscape. The activities associated with transporting the piles off site would cause soil disturbance and thus creating an environment favorable for exotic weed establishment. Burning these piles in place, in contrast, would cause little disturbance to soils, native plants and wildlife and would be substantially more cost effective due to less cost of personnel and equipment.

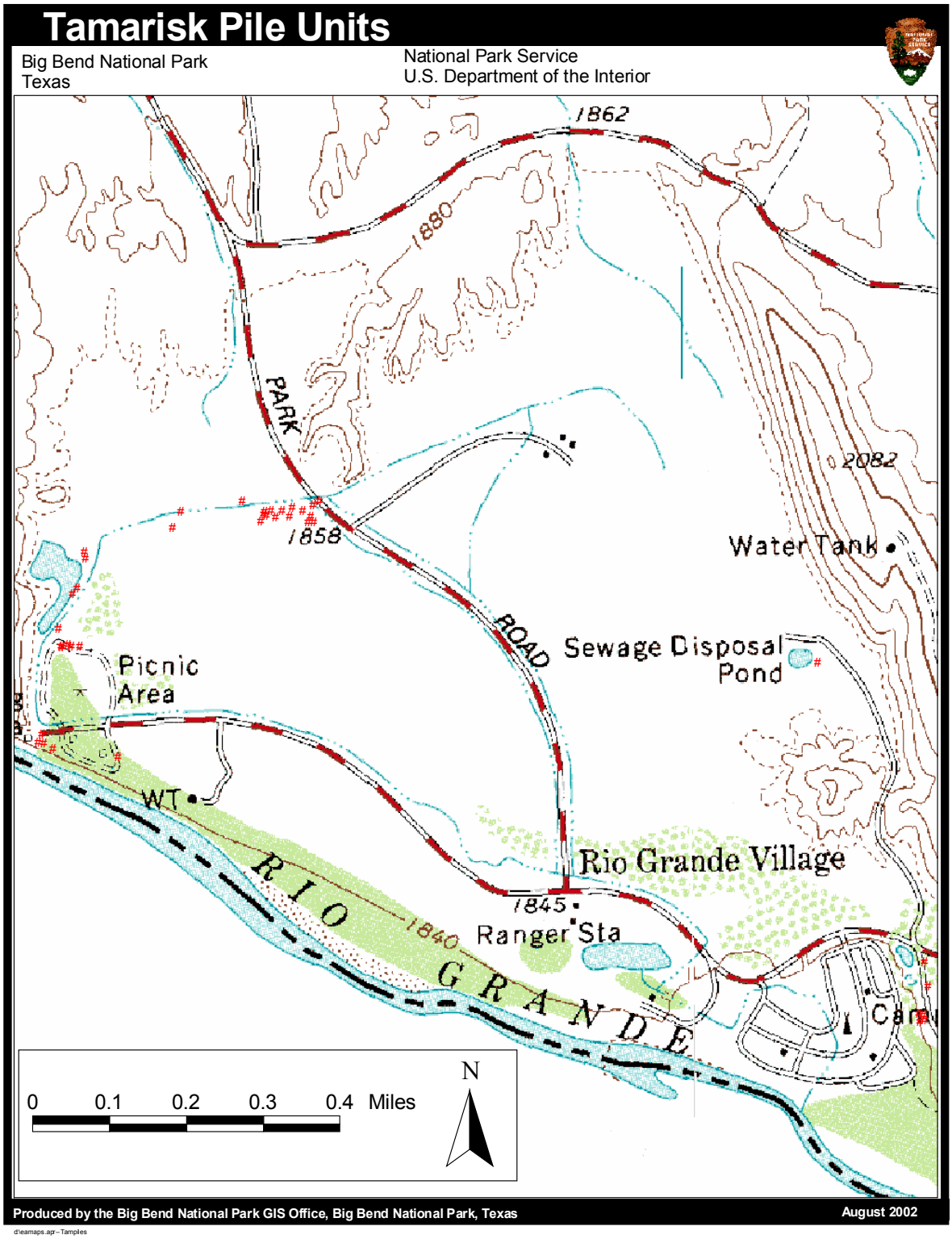

Figure 6. Location of individual tamarisk piles at Rio Grande Village at Big Bend National Park, TX. The tamarisk treatment are is about 4 acres with the piles occupying less than one acre.

I.B.2 Purpose of Action.

The purpose of this federal action is to implement a portion of the long-range fire management plan utilizing the benefits of fire to achieve desired natural resource conditions while protecting park resources and surrounding lands from uncontrolled wildland fire.

The proposed action is implementation of a management ignited prescribed fire. This environmental assessment (EA) analyzes fire management program alternatives and their direct, indirect and cumulative impacts. Of the two alternatives being analyzed, Alternative 2, implementation of the management ignited prescribed fire proposals is the NPS preferred alternative. Alternative 1 is a no action alternative.

Prescribed fire is an important tool in accomplishing holistic ecosystem management and would be used in the proposed areas to replicate the role of natural fire, in a controlled manner by:

> Improving conditions suitable for grassland regeneration and forest health and enhancing plant communities by facilitating nutrient cycling. Improving wildlife habitat, specifically for pronghorn antelope, Big Bend Gambusia, black bear, whitetail deer, mule deer and black-capped vireo and a host of other species by enhancing forage production, promoting the growth of native forbs and grasses and reducing juniper cover. The principal habitat change in the brush/grassland would be in the size class structure of the vegetation. Prescribed fire would reduce the number of large shrubs and conversely increase the number smaller size shrubs. Grass cover could possibly increase, but this out come is less certain, thus monitoring this site will be critical. The principal habitat change in the forest would be reduction in juniper density, enhanced vigor of the understory grasses, a more open forest savanna, an increase in snag availability for birds, bats and small mammals. The more open forest structure due to reduced tree stocking would decrease competition for water thus moisture stress on remaining trees would be reduced and thus improve the overall forest /woodland health. Burning the *Gambusia* unit would increase the amount of available habitat for a federally endanger species, thus reducing vulnerability of the species to extinction. Reducing fuel accumulations to within the range of natural variability to a more natural condition in order to manage fire occurrence and intensity in the area.

In summary, it is desirable in the proposed burn units to reduce hazardous fuel loads, restore fire as a natural process to maintaining biological diversity and ecological function, to gain a fundamental understanding of fire in recovering desert grasslands, facilitate the recovery of endanger fish habitat, and to remove of woody debris associated with exotic plant control.

I.C Objectives of Fire Management and Planning

National Park Service (NPS) Management Policies (2001, sec 4.0) direct individual parks to manage natural resources and to maintain, rehabilitate, and perpetuate their inherent integrity. One of the primary management objectives of BBNP is to manage all natural resources, to the degree possible, using holistic ecosystem concepts in order to perpetuate natural systems. Since periodic fire is a major ecological processes having the potential to affect virtually every other resource, its proper management is viewed as critical. Fire management is a key component of the park's overall resource management program (NPS Mgmt Policies, 2001, sec 4.5).

The proposed action is consistent with the Fire Management Plan (National Park Service 1994) goals. As directed by the policies implicit in legislation, in National Park Service policy guides, and in park management plans, an overall management goal for Big Bend National Park is the perpetuation of natural ecological process. This goal is tempered, however, by the location of developed areas within the park and their association with hazardous fuels and by contrasting uses on adjacent lands. In such localities, the agency and park focus is the protection of life and property through fuel reduction, fire prevention, and suppression of fires. Future interagency agreements will consider cooperative management of fires along park boundaries. Specific goals of the park's fire program are as follows:

- Allow fire to resume its natural role as a dynamic ecosystem process, to the maximum extent possible.

- Avoid unacceptable environmental impacts of wildfire and fire management techniques on the natural and cultural resources of the park.

- Prevent human-caused wildfire and provide for rapid, aggressive, economically sound, and safe suppression of all fires which do not meet management objectives.

- Cooperate fully with adjacent land management agencies and private landowners in the management of fire near park boundaries.

- Encourage public understanding and support for the fire management program at Big Bend National Park.

The Fire Management Program has the following specific objectives:

- Base the program on sound data obtained through scientific research and monitoring.

- Designate and describe fire management units for the park and define fire management strategies and prescriptions for the these units.

- Assign fire management responsibilities and outline procedures for staff response to wildfire and prescribed natural fire.

- Rehabilitate areas disturbed by fire suppression actions.

- Provide the necessary organization and training for team members so that they will be able to fulfill their duties and responsibilities in a safe and responsible manner.

- Develop mutual aid fire management agreements with adjacent land management agencies and private landowners.

- Conduct a fire prevention program, to include reduction of hazardous fuels, so that human life, property, and natural and cultural resources are protected.

- Initiate a public information and interpretation program which will encourage visitor and community support of the park's fire management program.

I.C.1 Specific Burn Unit Objectives

The proposed management-ignited fires are designed to meet several resource management, hazard fuel reduction, and public safety goals (Table 1).

Table 1. Specific objects for each of the proposed prescribed burn units.

Site Name	Treatment Acres	Treatment Objectives
RGV Wetland Gambusia	9.1	Aid the establishment of native vegetation. A 75% - 95% canopy reduction in the brush and mesquite is desired
Comanche Draw	537	Enhance native grasses and shrubs and increase plant diversity. A 35% - 50% canopy reduction in the brush and mesquite and an increase in grass cover in 5 years. Document the effects of fire in degraded grassland/shrubland communities were the effects of fire are largely unknown. Measure the intensity of fires within these communities and fire intensity effects on the seed bank and vegetation recovery.
Tamarisk Piles	4	Hazardous fuel reduction, enhance aesthetics and remove safety hazards.
Southeast Rim	343	Reduce hazardous fuels and document the effects of low intensity fire in the Chisos Mountains. Reduce dead and down fuels by 25 – 30%. Reduce seedlings and saplings by 40%. Remove ladder fuels within 2 feet of ground level. Mortality in trees greater than 6" dbh (diameter at breast height) will be less than 25%

I.D Issues and Impact Topics Included in this EA

Issues and concerns were identified by specialists in the National Park Service (NPS), as well as from the input of the public and other federal, state, and local agencies. Public scoping for this EA was conducted from February 2000 through March 2000 utilizing a mail-out letter. Impact topics are the resources of concern that could be affected by the range of alternatives. Specific impact topics were developed for discussion focus to ensure that alternatives were compared on the basis of the most relevant topics. These impact topics were identified on the basis of federal laws, regulations, and orders; NPS Management Policies (2001); and NPS knowledge of limited or easily impacted resources. A brief rationale for the selection of each impact topic is given below, as well as the rationale for not considering further specific topics.

I.D.1 Issues Identified

Issue: Fire events within the project area may have adverse impacts on cultural resources.

Issue: Fire must be controlled to protect all T/E species, prevent escape and minimize post-fire erosion.

Issue: Fire emissions may degrade air quality.

Issue: Fire effects should be monitored.

I.D.2 Issues whose impacts could be mitigated and not analyzed further

Issue: What will be the prescribed fire return interval for re-treating the brush.

Mitigation: Brush cover will be maintained at a level that does not adversely affect grass cover. Post fire monitoring will measure both grass and shrub cover over a ten year period. Monitoring will be designed to detect biologically significant change in both grass and shrub canopy cover. The fire return interval for re-treating the brush can range from 5-25 years, determined largely by the magnitude of annual precipitation.

Issue: Maintaining control of the Management Prescribed Fire.

Mitigation: The prescribed fire will not be conducted if environmental conditions suitable for maintaining control and adequate personnel are not available. Burn units will also be configured to minimize the risk to personnel executing the burn and enhancing their ability to hold the burn to within the boundaries of the burn units.

Issue: If the Gambusia burn is conducted after mid-March, there may be negative impacts on nesting and migratory birds.

Mitigation: Do not conduct burn during nesting season (mid- to late February through June).

Issue: Because the proposed burn (particularly Block 1) is close to the Rio Grande Village Campground, smoke and fire-related activity may cause disturbances to visitors and put them at risk in the event of an escaped fire.

Mitigation: Conduct burn during the off season to avoid peak use period of campground (Spring Break). Close the northeast corner of the campground (no generator use zone) for a period of time until the burn can be conducted. During the burn, provide staff from the division of Interpretation & Visitor Services to interpret the burn on-site, and have all staff working at entrance stations caution visitors of the fire activity and potential smoke and noise disturbances.

Issue: Smoke from the burning piles of tamarisk (Tamarisk Piles Burn) will temporarily diminish visibility and may have negative impacts on visitor experience.

Mitigation: Conduct the burn during the off-season to avoid peak use period of campground (Spring Break). During the burn, provide staff from the division of Interpretation & Visitor Services to interpret the burn on-site, and have all staff working at entrance stations caution visitors of the fire activity and potential smoke disturbances.

Issue: Burns may affect visitor use.

Mitigation: Except the SE Rim burn proposal, the areas are in remote locations that are not typically visited by the park visitor. The preferred timing of the burns will be during the slowest visitor use seasons, thus having a negligible effect on visitor use.

Issue: Burns may affect park operations.

Mitigation: The project areas are in remote locations and will not conflict with park operations. The timing of the burns is also during the slowest visitor use season, interference with park operations will be negligible**.**

Issue: Burns may affect prime and unique farmlands.

Mitigation: In August, 1980, the Council on Environmental Quality (CEQ) directed that federal agencies must assess the effects of their actions on farmland soils classified by the U.S. Department of Agriculture's Natural Resource Conservation Service as prime or unique. Prime or unique farmland is defined as soil, which particularly produces general crops such as common foods, forage, fiber, and oil seed; unique farmland produces specialty crops such as fruits, vegetables, and nuts. The proposed units do not have soils that are designated as prime or unique, therefore impacts to prime or unique farmlands were dismissed as a topic from this document.

Issue: Burns may affect the socioeconomic environment.

Mitigation: The proposed action would neither change local and regional land-use nor negatively impact local businesses or other agencies. While there are 2 communities at the west entrance to the park, their employment base is seasonal. Fire events may bring a short-term need for additional personnel in the park, but this would be minimal (less than 5-8 people) and would not significantly affect the communities' overall population, income and employment base. The Comanche Draw project area is more than one-half mile west of the nearest paved road. The Tamarisk Piles Burn is out of the Rio Grande Village (RGV) Developed Area. The Gambusia Burn is immediately adjacent to the RGV campground. A section of campground would be closed for up to three days, during a time when the campground is receiving less than 50% occupancy. During treatment of the SE Rim unit, two formal trails to the area would be closed to park visitors for a period of two to five days, which would have negligible impacts upon park visitation. The impact of closing the trails is mitigated by the timing of the burn; during the slowest visitor period of the year. The fire and the smoke it generates, as well as any suppression and monitoring activities, would cause little, if any, inconvenience to the visitor. Therefore, the socioeconomic environment related to the burn units will not be addressed as an impact topic in this document.

Issue: Environmental justice must be considered.

Mitigation: Executive Order 12898, "General Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," requires all federal agencies to incorporate environmental justice into their missions by identifying and addressing disproportionately high and adverse human health or environmental effects of their programs and policies on minorities and low-income populations and communities. The proposed action would not have health or environmental effects on minorities or low-income populations or communities as defined in the Environmental Protection Agency's Draft Environmental Justice Guidance (July 1996). Therefore, environmental Justice was dismissed as an impact topic in this document.

I.D.3 Topics Included in this EA

Air Quality: The 1963 Clean Air Act (42 U.S.C. 7401 et seq. amended 1979) stipulates that federal land managers have an affirmative responsibility to protect a park's air quality related values (including visibility, plants, animals, soils, water quality, cultural resources, and visitor health) from adverse pollution impacts. Section 118 of the Clean Air Act requires a park to meet all federal, state, and local air pollution standards. Air quality would be affected to various degrees by fire events inside the park. Direct, indirect, and cumulative air quality impacts are therefore analyzed in this EA.

Cultural Resources: The National Historic Preservation Act, as amended in 1992 (16 USC 470 et seq.); the National Environmental Policy Act; and the National Park Service's Cultural Resource Management Guideline (1994), Management Policies (2001), and NEPA Compliance Guideline (1982), require the consideration of impacts on cultural resources listed on or eligible for listing on the National Register of Historic Places. The Native American Graves Protection and Repatriation Act (NAGPRA) of 1990 (25 USC 3001) requires specific actions when Native American human remains, funerary objects, sacred objects, and objects of cultural patrimony are excavated or discovered on federal lands.

The undertakings described in this document are also subject to Section 106 of the National Historic Preservation Act, under the terms of the 1995 Programmatic Agreement among the National Park Service, the Advisory Council on Historic Preservation, and the National Conference of State Historic Preservation Officers. This document will be submitted to the Texas State Historic Preservation Officer for review and comment.

The alternatives analyzed in this EA consider strategies to use fire as a tool to restore the cultural landscape as well as protect known resources from adverse affects of fire, therefore, impacts to cultural resources are analyzed in this EA.

Vegetation and Wildlife: The National Environmental Policy Act (NEPA) (1969) calls for an examination of the impacts on all components of affected ecosystems. National Park Service policy is to maintain all the components and processes of naturally evolving park ecosystems, including the natural abundance, diversity, and ecological integrity of plants and animals (NPS Management Policies, 2001).

The Endangered Species Act (1973) requires an examination of impacts on all federally threatened or endangered species. National Park Service policy also requires examination of the impacts on federal candidate species, plants and animals as well as state-listed threatened, endangered, candidate, rare, declining, and sensitive species. There are several rare plant species within the proposed project areas that are evaluated in the EA.

Soil and Water Resources (Water Quality, Wetlands, and Floodplains): National Park Service policies require protection of water quality consistent with the Clean Water Act. Special consideration of impacts on floodplains and wetlands is also required by Executive Orders 11988 (Floodplain Management) and 11990 (Protection of Wetlands). NPS guidelines (Floodplain Management and Wetland Protection Guidelines, Federal Register, Vol. 45, #104, 35916-35922, May 28, 1980; National Park Service Floodplain Management Guidelines (Special Directive 93-4), 1993; and Director's Order #77-1: Wetland Protection, 1998) provide procedures for implementing these orders. Water quality may be affected by increases in nutrients. Fire may also increase soil erosion, both immediately after a fire event when storm patterns bring intense rainfall into the area and over several years due to a decrease in vegetative cover. National Park Service policies and Special Directive 91-6 require the consideration of impacts on soils.

Cumulative Impacts: The Council on Environmental Quality (CEQ) regulations, which implement the NEPA act, requires assessment of cumulative impacts in the decision-making process for federal projects. Cumulative impacts are defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions" (40 CFR 1508.7). Cumulative impacts are considered for both the no-action and proposed action alternatives.

I.E Compliance and Authority for Action

In compliance with the National Environmental Policy Act (NEPA), and following the release of the Interagency Fire Policy Review Team report (USDA/USDI 1989), an environmental assessment has been prepared. Requirements of the National Historical Preservation Act (NHPA) have been met through a review by park and regional archeologists and an additional review requested by the Texas State Historic Preservation Office.

II ALTERNATIVES CONSIDERED

II.A Alternatives Analyzed in the EA

Alternative A: No Action The proposed prescribed burns described in this document would not be conducted. Under the No-Action Alternative, no changes in management would occur for the Southeast Rim Unit, the Comanche Draw burn unit, the RGV Wetland -Gambusia habitat burn unit and the Tamarisk piles burn unit. Resource needs prompting these management actions would not be addressed and thus continue in their present state or require other more intrusive and expensive actions that were excluded from analysis in this document. By not implementing these burns the directives of Big Bend National Park's establishing legislation, General Management Plan, Resource Management Plan and Fire Management Plan and the Organic Act of 1916 would not be met.

Southeast Rim Unit

Suppression of all fire in the Southeast Rim Unit would continue (Figure 3), thus continuing the accumulation of fuel. The increase of downed and woody debris and an increasing density of younger trees will greatly increase the potential for a large catastrophic wildland fire on the Southeast Rim. Such an event could irreparably impair the current mature pinyon-juniper-oak forest on the Southeast Rim. Where possible, the ultimate objective for fire management for the Chisos Mountains is to allow natural low intensity surface fires to resume their ecological function in the Chisos Mountains. By not reducing incrementally the present fuel loading through judicial use of prescribed fire a catastrophic event will, in all likelihood be realized, resulting in the loss of valued mature and old growth woodland and forest. Under the current Fire Management Plan all natural and human caused fires will continue to be suppressed.

Comanche Draw Unit

The grassland vegetation within the Comanche Draw burn unit (Figure 4) would not benefit from a release of nutrients as a result of a fire. The competition for the limited available nutrients between the mature brush and the grassland would continue. The grassland/brush community density and species coverage would not change toward a more natural grassland vegetation community.

RGV Wetland-Gambusia Unit

The habitat improvement for the Gambusia gaigei would not occur or would require other more intrusive methods, and probably at much greater expense (Figure 5). Consequently habitat restoration could be greatly delayed, due to funding delays or shortfalls. Additional delays may be encountered as alternative treatments are assessed for effectiveness, while continuing to expose the species to a greater risk of extinction. Under present management the present stand of trees and brush would persist and further encroach in to the remaining habitat. The hydrologic flow critical for the G. gaigei habitat would continue to be reduced preventing species habitat recovery.

Tamarisk Pile Unit

The tamarisk piles would continue to be a potential safety hazard to park visitors who might wander into the area (Figure 6). The large piles would also remain aesthetically displeasing to visitors. Some of the tamarisk piles are hindering the maintenance of the Rio Grande Village area.

Alternative B: Proposed Action The four proposed prescribed burns not included in the current Fire Management Plan would be implemented under the environmental conditions prescribed in the prescribed burn plan. These plans identify parameters under which each prescribed burn would be carried out to meet the objectives outlined in the burn plan while minimizing the risk of an escaped prescribed burn

The National Park Service proposes to use Management Ignited Prescribed Fire in Big Bend National Park during the 2002 calendar year at four specific locations that were not identified in the approved Fire Management Plan (National Park Service 1994). The Fire Management Plan allows fire use as an adaptive management tool for these additionally proposed burns. The burns are to be conducted for the general purpose of resource benefit and hazardous fuel reduction. Ignition would occur during the summer and fall months in appropriate environmental conditions that support burn objectives.

The project areas objectives would be evaluated and measured by establishment of fire effects monitoring plots, fuel load transects and photo points were appropriate.

Specific objectives for each burn are listed below:

Southeast Rim Unit.

This burn is located on the Southeast Rim of the Chisos Mountains, including upper sections of Boot Canyon, and Townsend Peak (Figure 3). The burn is approximately 343 acres in the pine, oak and juniper forest. The primary

objective of the burn is to reduce fuel loading in the unit. Fire related mortality of the mature trees (>6“ DBH) would be kept at less than 25%, as a part of the burn objectives. However, small juvenile juniper trees are specifically targeted species because of their ability to aggressively encroach and compete for water. The objectives also include a minimal 25%- 30% reduction of dead and down fuels, a 40% or greater mortality of seedlings and saplings, and a reduction of ladder fuels within two feet of ground fuels in order to prevent surface fires from ascending into the woodland canopy. The fuel reduction objectives will be accomplished by a low intensity surface or ground fire. A secondary objective is to document the effects of low intensity fires in the Chisos Mountains. Fire effects monitoring plots have been established to achieve this objective. The burn is designed to reduce the potential for catastrophic fire in this forest. The burn block is approximately 10% of all acres of similar vegetation type. This burn may need to be repeated several times to incrementally reduce the fuel loading and achieved the desired condition for this woodland community. The desired condition for the woodland community and the other woodland and forest in the Chisos to support low intensity surface fires and minimize the risk of large-scale catastrophic stand replacing events.

Comanche Draw Burn.

This burn is located in the Comanche Draw drainage west of Park Route 11 (Hwy 385) between mile markers 18 and 20, approximately 6 miles south of Persimmon Gap. The burn would affect about 537 acres of shrub desert vegetation. The objectives of the burn are to enhance native grasses and increase plant diversity. A 35% - 50% canopy reduction in the brush and mesquite and an increase in native grass cover within 5 years are the measurable targets for the initial treatment. The exotic species, johnsongrass, would not be burned in this Burn Block. This burn is also being proposed to gain information on the role of fire in degraded desert scrub community

RGV Wetland - Gambusia *Burn.*

This burn is located in the Rio Grande Village Developed Area, east of the campground. Five separate blocks of brush extend from the eastern edge of the campground to the river. A service road separates the burn blocks from the campground and the Big Bend Gambusia refugium, the pond containing the endangered fish. The burn would only be ignited with strong N to NW winds, keeping smoke and ash from impacting the refugium, the RGV Developed Area and the campground. The Berkely Cottage, adjacent to one of the five blocks, will be protected from burn impacts. The burn is approximately 10 acres of dense brush Acacia sp., creosote, mesquite trees and grass. The objective of the burn is to aid the establishment of native wetland vegetation including willows, alkali sacaton and little bluestem. A 75% - 95% canopy reduction in the brush and mesquite is desired.

Tamarisk Pile Burn.

This burn is located in Rio Grande Village Developed Area, along an old irrigation ditch connecting the residential area and the settling ponds. The pile burns are approximately four acres of tamarisk (salt cedar) trees that have been cut and piled (approximately 40 piles) in adjacent bare areas. The objectives of the burn are hazardous fuel reduction and exotic species eradication. Park staff is cutting and chemically treating the live tamarisk to eradicate this exotic species. Burning the piles is the most cost-effective method of removing the debris from the eradication program. 100% removal of tamarisk is the objective of both mechanical and burn treatments.

II.B Alternatives Considered and Dismissed from Further Consideration

Mechanical Reduction Treatments

Mechanical reduction treatments were dismissed from consideration because of the greater soils disturbance associated with such treatments. Also reducing fuels is problematic since this would require transporting woody fuels off the site, thus compounding the soil disturbance problem. Also such treatments are not practical for the southeast rim where access is limited to hiking or pack trails. And with the amount of woody fuels requiring removal prescribed fire is the only viable treatment. Additionally mechanical treatments would not provide the nutrient cycling benefit that burning would provide.

Chemical Treatments

Chemical treatments are not viable alternatives for the RGV Wetland-Gambusia project given its proximity to the Rio Grande River. The herbicide could also possibly adversely impact the remaining endanger fish habitat and not compatible with wetland restoration. Chemical treatments would do little to reduce fuel loadings, but could increase fuel loadings and exacerbate a catastrophic wildland fire event, particularly in the southeast rim area. With regards to the Comanche Draw burn the objective is to reduce shrub cover and not necessarily extirpate individual shrubs, application of herbicides is not compatible with this objective. Applications of chemicals would not reduce the woody debris of the tamarisk piles.

Table 2. Prescribed burn objectives, and the ability of the alternatives to meet them.

Objective	Alternative A: Continue Current Management/No Action	Alternative B: Preferred Alternative
RGV Wetland - Gambusia: Aid the establishment of native wetland vegetation.	Endangered species habitat would not benefit from restoration efforts using prescribed fire as a restoration tool. Exotic species (tamarisk) would not be reduced. Invasive species (mesquite) would increase.	Implementation of prescribed burning would complete the desired vegetation change in a cost-effective manner and replace the costly mechanical thinning actions
Comanche Draw: Enhance native grasses and shrubs and increase plant diversity. Document the effects of fire in degraded grassland/shrubland communities.	This objective will not occur without some disturbance to alter the current system and provide opportunity to change the vegetation status that exists. Research to document the effects of fire in degraded grassland/shrubland communities would not be possible.	The proposed actions will introduce a disturbance (prescribed fire) providing the vegetation community an opportunity to achieve the objective. Research documentation of the fire effects would be completed.
Tamarisk Piles: Hazardous fuel reduction; enhance visual aesthetics and remove safety hazards.	Reduction of exotic species (tamarisk) would occur only on a sporadic and unplanned basis, such as when coinciding with another activity (i.e. hazard tree removal). The tamarisk piles that exist due to previous mechanical reduction would not be eliminated. Re-sprouting of the cut stumps would continue. Potential safety hazard would remain.	The preferred action would reduce exotic species (tamarisk), the piles resulting from mechanical reduction and the re-sprouting of the cut stumps. The removal of the obvious piles, visible from the Daniels Ranch - Hot Springs Trail would improve the aesthetics of that trail. Potential safety hazard would be removed.
SE Rim: Reduce dead/down woody material. Document the effects of low intensity fire in the Chisos Mountains. Reduce seedlings and saplings; remove ladder fuels. Keep mortality in large trees less than 25%.	Objective will not be met. Dead and down woody fuels and ladder fuels will continue to increase on SE Rim. Seedlings/saplings would continue to increase. No effects of low intensity fire would be documented. Potential for large tree mortality would continue to be at risk from wildland fire during extreme conditions.	This alternative would reduce fuel loads (dead/down, ladder, seedlings/saplings) thus decreasing the potential for catastrophic wildfires. Fire effects would be documented. Burn unit prescriptions would permit the best opportunity to keep mortality low with a controlled application of fire use and at the most cost-effective method of reducing the dead/down woody material.
All Burn Units: Manage prescribed fires in concert with federal, state, and local air quality regulations.	Wildland fires normally occur during poor air quality months. The potential for catastrophic wildland fire would increase and with it, the potential for higher volumes of emissions into the air shed.	The proposed prescribed burns would be implemented in such a way so as to have minimum impact on air quality. Prescribed fire would be implemented using acceptable smoke management practices.

II.C Environmentally Preferred Alternative

Environmentally preferable alternative is defined as "the alternative that will promote the national environmental policy as expressed in the National Environmental Policy Act's §101. Ordinarily this means the alternative that causes the least damage to the biological and physical environment; it also means the alternative which best protects, preserves and enhances historic, cultural, and natural resources"("Forty Most Asked Questions Concerning Council on Environmental Quality's [CEQ] National Environmental Policy Act Regulations," 1987).

Section 101 of the National Environmental Protection Act states that "… it is the continuing responsibility of the Federal Government to …(1) fulfill the responsibilities of each generation as trustee of the environment for succeeding generations; (2) assure for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings; (3) attain the widest range of beneficial uses of the environment without degradation or

risk to health or safety, or other undesirable and unintended consequences; (4) preserve important historic, cultural and natural aspects of our natural heritage, and maintains, wherever possible, an environment that supports diversity, and variety of human choice; (5) achieve a balance between population and resource use that permit high standards of living and a wide sharing in life's amenities; and (6) enhance the quality of renewable resources and approach the maximum attainable recycling of depleted resources." The environmentally preferable alternative of the Management Ignited Prescribed Fires for 2002 and 200 is based on these national environmental policy goals.

Alternative A represents the current management direction for the Southeast Rim, Comanche Draw, RGV Wetland-Gambusia and Tamarisk Pile Units, in that prescribed fire is not addressed as means to meet national environmental policy goals. Consequently, this management action fails to address critical goals of best protecting and preserving cultural and natural resources for ensuing generations, provision 1 of the goals. For the Southeast Rim, alternative A does not address the cumulated effects of continued vegetation accumulation on the Southeast Rim, thus predisposing the ecosystem to extreme wildfire events outside the range of natural variability. With respect to the Comanche Draw Unit, it does not address the insufficient knowledge of fire's ecological function in historically disturbed shrubland/grass ecosystems. While the current management direction for the RGV Wetland-Gambusia Unit, serves to protect remaining habitat and maintain the population of the species in an artificial environment and partially meet the goals of the Endangered Species Act, it is not proactive in enhancing potential habitat and further protecting the species and thus fails to more fully realize provision 4 of the national environmental policy goal. Current management direction also does not have a means of preserving values embodied by the Boquillas Valley Cultural Landscape that may be adversely affected by other resource protection activities such as exotic species control that have resulted in piles of cut tamarisk scattered throughout the valley, an activity that falls short of provision 2 of national environmental policy goal.

Alternative B, represents the most viable set of management actions that meet the broadest range of the national environmental policy goals for the Southeast Rim, Comanche Draw, RGV Wetland-Gambusia and Tamarisk Pile Units. For the Southeast Rim, maintaining fuel loads within the range of natural variability by the judicial use of prescribed fire would sustain the resiliency of the forest and woodland ecosystem to fire disturbances thus meeting provisions 2 and 4 of the national environmental policy goals. Carrying out the prescribed burn in the Comanche Draw Unit would augment our knowledge of the dynamics of fire within these and other similar plant communities within the park so that we can develop appropriate fire management strategies within these systems to more fully realize the goals of national environmental policy. Implementing prescribed fire in the RGV Wetland-Gambusia Unit to provide more available habitat for endanger species would more fully meet the goals of the Endangered Species Act in protecting habitat and provisions 1 and 4 of the national environmental policy goals. By disposing of the tamarisk piles through burning cultural values of the Boquillas Valley landscape would be retained and not deter other critical resource protection activities thus meeting provisions 1, 2 and 4 of the national environmental policy goals.

The environmentally preferable alternative is Alternative B, because it surpasses Alternative A in more fully realizing a broader range national environmental policy goals as stated in §101 of the National Environmental Policy Act. While Alternative A maintains the present status of the environment by protecting ecosystems, species and cultural resource as well as providing for visitor experience, it fails to address cumulative effects that in the future pose a significant threat to the resources, it also fails to facilitate the acquisition of additional knowledge to more effectively manage a resource in accordance with the National Environmental Policy Act. And while it protects the current habitat of an endangered species, it fails to make provision that may further protect the species. Additionally, while it has an overarching goal of protecting cultural landscapes it fails to manage other management activities that may inadvertently detract from that value. Alternative B, augments A's overall objective in meeting the goals of the National Environmental Protection Act by addressing Alternative A's shortcomings directly and thus facilitates the park in more fully meeting the goals of the National Environmental Protection Act.

Table 3. Definitions for the prescribes burn environmental assessment impacts threshold .

Impact Topic	Impact Threshold Definition				Duration
	Negligible	Minor	Moderate	Major	
Air quality	No changes would occur or changes in air quality would be below or at the level of detection, and if detected, would have effects that would be considered slight and short-term.	Changes in air quality would be measurable, although the changes would be small, short-term, and the effects would be localized. No air quality mitigation measures would be necessary.	Changes in air quality would be measurable, would have consequences, although the effect would be relatively local. Air quality mitigation measures would be necessary and the measures would likely be successful.	Changes in air quality would be measurable, would have substantial consequences, and be noticed regionally. Air quality mitigation measures would be necessary and the success of the measures could not be guaranteed.	Short Term- Recovers in 7 days or less Long Term- Takes more than 7 days to recover
Cultural resources	The impact is at the lowest levels of detection – barely perceptible and not measurable.	For archeological resources, the impact affects an archeological site(s) with modest data potential and no significant ties to a living community's cultural identity. The impact does not affect the character defining features of a National Register of Historic Places eligible or listed structure, district, or cultural landscape.	For archeological resources, the impact affects an archeological site(s) with high data potential and no significant ties to a living community's cultural identity. For a National Register eligible or listed structure, district, or cultural landscape, the impact changes a character defining feature(s) of the resource but does not diminish the integrity of the resource to the extent that its National Register eligibility is jeopardized.	For archeological resources, the impact affects an archeological site(s) with exceptional data potential or that has significant ties to a living community's cultural identity. For a National Register eligible or listed structure, district, or cultural landscape, the impact changes a character defining feature(s) of the resource, diminishing the integrity of the resource to the extent that it is no longer eligible to be listed in the National Register.	Short term- Treatment effects on the natural elements of a cultural landscape may be comparatively short-term (e.g., three to five years until new vegetation grows or historic plantings are restored, etc.) Long term- Because most cultural resources are non-renewable, any effects on archaeological, historic, or ethnographic resources, and on most elements of a cultural landscape would be long term.
Endangered or	No federally listed species would be	The alternative would affect an individual(s)	An individual or population of a listed	An individual or population of a listed	Plants

Impact Topic	Impact Threshold Definition				Duration
	Negligible	Minor	Moderate	Major	
threatened species and critical habitats	affected or the alternative would affect an individual of a listed species or its critical habitat, but the change would be so small that it would not be of any measurable or perceptible consequence to the protected individual or its population. Negligible effect would equate with a "no effect" determination in U.S. Fish and Wildlife Service terms.	of a listed species or its critical habitat, but the change would be small and would be short-term. Minor effect would equate with a "may effect" determination in U.S. Fish and Wildlife Service terms and would be accompanied by a statement of "likely…" or "not likely to adversely affect" the species.	species, or its critical habitat would be noticeably affected. The effect would have some long-term consequence to the individual, population, or habitat. Moderate effect would equate with a "may effect" determination in U.S. Fish and Wildlife Service terms and would be accompanied by a statement of "likely…" or "not likely to adversely affect" the species.	species, or its critical habitat, would be noticeably affected with a long-term, vital consequence to the individual, population, or habitat. Major effect would equate with a "may effect" determination in U.S. Fish and Wildlife Service terms and would be accompanied by a statement of "likely…" or "not likely to adversely affect" the species or critical habitat.	Short Term- Recovers in less than 1 year Long Term- Takes more than 1 year to recover Animals Short Term- Recovers in less than 1 year Long Term- Takes more than 1 year to recover
Vegetation	No native vegetation would be affected or some individual native plants could be affected as a result of the alternative, but there would be no effect on native species populations. The effects would be short-term, on a small scale, and no species of special concern would be affected.	The alternative would temporarily affect some individual native plants and would also affect a relatively minor portion of that species' population. Mitigation to offset adverse effects, including special measures to avoid affecting species of special concern, could be required and would be effective.	The alternative would affect some individual native plants and would also affect a sizeable segment of the species' population in the long-term and over a relatively large area. Mitigation to offset adverse effects could be extensive, but would likely be successful. Some species of special concern could also be affected.	The alternative would have a considerable long-term effect on native plant populations, including species of special concern, and affect a relatively large area in and out of the park. Mitigation measures to offset the adverse effects would be required, extensive, and success of the mitigation measures would not be guaranteed.	Short Term- Recovers in less than 3 years Long Term- Takes more than 3 years to recover
Wildlife	Wildlife would not be affected or the effects would be at or below the level of detection,	Effects to wildlife would be detectable, although the effects would be localized, and would be	Effects to wildlife would be readily detectable, long-term and localized, with	Effects to wildlife would be obvious, long-term, and would have substantial	Short Term- Recovers in less than 1 year Long Term- Takes more than 1 year to

Impact Topic	Impact Threshold Definition				Duration
	Negligible	Minor	Moderate	Major	
	would be short-term, and the changes would be so slight that they would not be of any measurable or perceptible consequence to the wildlife species' population.	small and of little consequence to the species' population. Mitigation measures, if needed to offset adverse effects, would be simple and successful.	consequences at the population level. Mitigation measures, if needed to offset adverse effects, would be extensive and likely successful.	consequences to wildlife populations in the region. Extensive mitigation measures would be needed to offset any adverse effects and their success would not be guaranteed.	recover
Soils & Water Resources	Soils would not be affected or the effects to soils would be below or at the lower levels of detection. Any effects to soil productivity or fertility would be slight and no long-term effects to soils would occur. Neither water quality nor hydrology would be affected, or changes would be either non-detectable or if detected, would have effects that would be considered slight, local, and short-term.	The effects to soils would be detectable, but likely short-term. Effects to soil productivity or fertility would be small, as would the area affected. If mitigation were needed to offset adverse effects, it would be relatively simple to implement and likely successful. Changes in water quality or hydrology would be measurable, although the changes would be small, likely short-term, and the effects would be localized. No mitigation measure associated with water quality or hydrology would be necessary.	The effect on soil productivity or fertility would be readily apparent, long-term, and result in a change to the soil character over a relatively wide area. Mitigation measures would probably be necessary to offset adverse effects and would likely be successful. Changes in water quality or hydrology would be measurable and long-term but would be relatively local. Mitigation measures associated with water quality or hydrology would be necessary and the measures would likely succeed.	The effect on soil productivity or fertility would be readily apparent, long-term, and substantially change the character of the soils over a large area in and out of the park. Mitigation measures to offset adverse effects would be needed, extensive, and their success could not be guaranteed. Changes in water quality or hydrology would be readily measurable, would have substantial consequences, and would be noticed on a regional scale. Mitigation measures would be necessary and their success would not be guaranteed.	Soil: Short Term- Recovers in less than 3 years Long Term- Takes more than 3 years to recover Water Resources: Short Term- Following treatment recovery will take less than one year Long Term- Following treatment recovery will take longer than one year

Table 4. Summarization of impacts for the no action and preferred action alternatives.

Prescribed Burn: Impact Topics:	Continue Current Management / No Action Alternative	Preferred Action Alternative
Southeast Rim		
Air Quality	Direct local, short-term, negligible to minor adverse impacts to air quality could occur in the event of a wildland fire within the burn unit.	Minor impacts that are local, direct and have short duration. Smoke will dissipate in one to two days following the burn treatment
Cultural, Archeological, and Historical Resources	Direct, local permanent adverse impacts could occur in the event of an uncontrolled wildland fire. Such an event could consume burnable material or heat damage artifacts or contaminate elements of the cultural landscape.	Impacts will range from no effect to no adverse effect. (Table 9) Steps will be taken not to allow fire to cross vulnerable sites.
Vegetation	No action alternative will result in direct local long-term adverse impacts to the existing woodland/forest in the event of an uncontrolled wildland fire. Old growth stands would be impaired and the habitat of endangerd plants could be irreversibly altered.	Adverse impacts will be minor to moderate local direct and long-term. These effects will be to some individual trees, which will be necessary to reduce the accumulation of live and downed fuels and reduce the threat of catastrophic fire.
Wildlife	No action alternative will result in direct local long-term adverse impacts to the wildlife habitat in the event of an uncontrolled wildland fire. Such an event could change forest structure and other habitat parameters.	Adverse impacts to wildlife will be local direct and short-term. Long-term minor to moderate beneficial effects are anticipated.
Soil & Water Resources	No action alternative will result in direct local short-term adverse impacts to the soils and watershed in the event of uncontrolled wildland fire. Soil sterilization, accelerated soil erosion on steep north facing slopes and development of hydrophobic soils could impair hydrologic function. These effects would dissipate with vegetation recovery.	Under the mild to moderate conditions of the prescribed burn adverse impacts to soil and water resources are expected to be negligible to minor direct local and short-term
Comanche Draw		
Air Quality	Direct local, short-term, negligible to minor adverse impacts to air quality could occur in the event of a wildland fire within the burn unit.	Minor adverse impacts would be localized and of short duration.
Cultural, Archeological, and Historical Resources	Continued accelerated erosion could directly and locally adversely affect cultural resources permanently.	Direct, local impacts of prescribed fire range from no effect to no adverse effect (Table 8). Mitigating actions are avoidance where sites may be adversely impacted by fire.
Vegetation	No effect on native vegetation.	Direct, local short term adverse effects on shrubs and grass cover. Vegetation cover will decrease short term, but vegetation cover should approach pre-burn levels in three to five years.
Wildlife	No effects on wildlife populations.	Direct local short-term adverse effects.

Prescribed Burn: Impact Topics:	Continue Current Management / No Action Alternative	Preferred Action Alternative
		Adverse effects are offset by the long-term direct and local beneficial effects of enhanced wildlife habitat. Given the limited spatial scale of this project these benefits would be insignificant at the landscape scale.
Soil & Water Resources	Soil erosion would continue to be accelerated. Water infiltration will remain low limiting potential for grassland recovery. Given the present state of the site continuing present management will not further exacerbate the current degrading conditions.	Adverse impacts will be local, direct and short term. Any increases in erosion will be negligible to minor and short term, declining with recovery of the vegetation canopy. Rainfall infiltration will continue to be low.
RGV Wetland-*Gambusia* Prescribed Burn		
Air Quality	Direct local, short-term, negligible to minor adverse impacts to air quality could occur in the event of a wildland fire within the burn unit.	Effects of prescribed burning activities would be direct with some adverse, negligible to minor impacts local in extent and of short duration.
Cultural, Archeological, and Historical Resources	Long-term impacts could occur in the event a wildland fire moves beyond the boundary of the prescribed burn unit and adversely impacts directly the vegetative character of the cultural landscape. These impacts would be local and may take a long period to recover.	Direct, local impacts of prescribed fire range from no effect to no adverse effect (Table 6).
Vegetation	No impacts would occur to the existing vegetation.	Direct localized moderate adverse impacts of long duration are expected to occur to undesirable shrubs. Shrubs will recover in the long term without repeated burning treatments. While these impacts are significant at the local scale, they are diminished at the regional scale, given the abundance of mesquite in the adjacent landscape and across the region. Grasses will receive direct local benefits that can be sustained with repeated burning treatments.
Wildlife	Long-term impacts to the endangered Big Bend gambusia (*Gambusia Gaigei*) could be direct and permanent due to diminished habitat. Failure of the artificial refugium could imperil the species. No impacts to other wildlife species were found in the analysis.	The endangered Big Bend gambusia (*G. Gaigei*) could benefit directly, locally and long-term with restoration of it's former habitat. Direct, local adverse effects to other wildlife species would range from negligible to moderate short-term effects.
Soil & Water Resources	Present soil conditions would persist.	Direct, local and long term benefits to soils and hydrologic flow are expected as result of

Prescribed Burn: Impact Topics:	Continue Current Management / No Action Alternative	Preferred Action Alternative
	Long-term impacts to the hydrologic flow would be local, direct and of long duration if flow continues to be depressed. Continued dominance of mesquite on the site could exacerbate hydrologic conditions during periods of drought. Impacts would be local and direct with duration varying with the duration of drought periods.	reducing shrub cover and reestablishing native grass cover. Wetland soil conditions will be extended into the winter months and the water table elevated to possibly historic levels. Nutrient levels in springs would increase but impacts would be local, direct and minor in magnitude and of short duration.
Tamarisk Piles Prescribed Burn		
Air Quality	No impacts to air quality would occur if tamarisk piles were not burned.	Effects of tamarisk pile burning would be direct with some adverse, negligible to minor impacts local in extent and of short duration.
Cultural, Archeological, and Historical Resources	Continued presence of the tamarisk piles would be local, direct and of long duration detracting from the significance of the surrounding cultural landscape.	Effects of the managed prescribed fire range from no effect to no adverse effect (Table 7).
Vegetation	No effects on native vegetation are anticipated if piles are left unburned.	Since piles were placed on bare areas of soil no impacts are expected on native vegetation.
Wildlife	Piles left in place could provide shelter for small mammals, but the direct benefit of this would be highly localized and of long duration. Over all impacts to wildlife populations would be none to minor.	Direct impacts to wildlife, especially those taking up residence in the piles would be minimal and of short duration.
Soil & Water Resources	No effects to soil and water resources would occur.	Minor adverse impacts to soil resources would be direct and highly localized in extent and of relatively short duration. Water resources would not be impaired.

III Environmental Consequences

III.A Air Quality

III.A.1 Methods

This section describes the environmental consequences on air quality associated with the preferred action, alternative B and no action alternative, Alternative A. This section presents the regulations and policy for management, and then for each unit describes the effected environment, impact analysis, cumulative effects, and conclusion for the preferred action alternative, and then the no action alternative.

The analysis includes a brief description of the affected environment and an evaluation of effects. The impact analysis involved the following steps:

- Identify the area that would be impacted.
- Compare the area of potential impact with the resources that are present.
- Identify the intensity, context, duration (short- or long-term), and type (direct or indirect) of effect, both as a result of this action and from a cumulative effects perspective. Identify whether effects would be beneficial or adverse. The criteria used to define the intensity of impacts associated with the analyses are presented in Table 5.
- Identify mitigation measures that may be employed to offset potential adverse impacts.

The impact analyses were based on professional judgment using information provided by park staff, relevant references and technical literature, and subject matter experts.

III.A.2 Regulations and Policy

The 1963 Clean Air Act (42 U.S.C. 7401 et seq. amended 1979) stipulates that federal land managers have an affirmative responsibility to protect a park's air quality related values (including visibility, plants, animals, soils, water quality, cultural resources, and visitor health) from adverse pollution impacts. Section 118 of the Clean Air Act requires a park to meet all federal, state, and local air pollution standards. Air quality would be affected to various degrees by fire events inside the park. Direct, indirect, and cumulative air quality impacts are therefore analyzed in this EA.

The Council on Environmental Quality (CEQ) regulations, which implement the NEPA act, requires assessment of cumulative impacts in the decision-making process for federal projects. Cumulative impacts are defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions" (40 CFR 1508.7). Cumulative impacts are considered for both the no-action and proposed action alternatives.

III.A.3 Affected Environment

III.A.3.1 Southeast Rim

The treatment area is approximately 343 acres. The nearest developed area (Chisos Basin Developed Area) is approximately 2 miles to the west of the unit. The timing of the burn is during the slowest visitation period of the year. Considering motel occupancy, campground occupancy, employees and day use visitation, approximately 100 people could be occupying the developed area during the predicted burn window. This burn unit contains a live fuel loading of grass, brush and trees up to 35 feet in height. Prevailing winds are generally from a southeasterly direction. These winds will cause smoke to affect the developed area during any prolong burnout of the heavy fuels. Smoldering fuels will be sought out and piled to permit rapid burnout. Prescription wind direction and wind speed conditions desired for the achievement of objectives will carry unit smoke and emissions to the north of the developed area. To minimize the amount of area burning during ignition within each sub-unit, a slow-paced ignition technique will be utilized. The ignition of the unit will take place in scheduled sub-units over a period of several days.

III.A.3.1.1 Impacts of the Preferred Alternative

III.A.3.1.1.1 Impact Analysis

According to the Department of Environmental Quality, Big Bend National Park is designated a Class I air quality area under the 1963 Clean Air Act, as amended (42 U.S.C. 7401 et seq.). Air quality monitoring for western Texas is conducted in El Paso. Big Bend National Park is in attainment with national ambient air quality standards for particulate matter, sulfur dioxide, nitrogen dioxide, ozone, carbon monoxide, and lead.

Air quality would be temporarily degraded by hydrocarbons, nitrogen and sulphur dioxide generated by the prescribed fire on all burn units. Depending upon the quantity of smoke, the smoke or a light haze may be temporarily visible from the SE Rim Burn in the nearby communities of Study Butte and Terlingua, which are approximately 26 miles to the west. However, both emissions and smoke would be rapidly dissipated by air drainage, since air stagnation is rare at Big Bend National Park.

III.A.3.1.1.2 Cumulative Effects

Because impacts to air quality would be short-term and limited in extent no adverse cumulative impacts could be identified.

III.A.3.1.1.3 Conclusion

The preferred alternative will have minor impacts that are local, direct and be of short duration. Smoke will dissipate in one to two days following the burn treatment. Impacts would be minor to negligible. No impairment would occur to air quality as a result of the preferred action alternative.

III.A.3.1.2 Impacts of Alternative A

III.A.3.1.2.1 Impact Analysis

No impacts would occur to air quality as a result of the no action alternative.

III.A.3.1.2.2 Cumulative Effects

No cumulative effect could be identified in the analysis.

III.A.3.1.2.3 Conclusion

Direct local, short-term, negligible to minor adverse impacts to air quality could occur in the event of a wildland fire within the burn unit. No impairment to air quality could be identified in the environmental analysis as a result of the no action alternative, Alternative A.

III.A.3.2 Comanche Draw Unit

The treatment area is approximately 377 acres. The nearest developed area, Persimmon Gap is approximately 6 miles to the north of the unit. Up to 6 people could be occupying the Persimmon Gap developed area during the predicted burn window. A two-lane highway is 0.5 miles to the east and would have minimal traffic during the burn period. This burn unit contains a fuel loading of brush, a few small trees and patches of grass. Prevailing winds are generally from a southeasterly direction. These winds will cause smoke to affect the developed area during any prolonged burnout of the heavy fuels. Smoldering fuels will be sought out and piled to permit rapid burnout. Wind direction and wind speed conditions desired for the achievement of the objectives will carry smoke and emissions to the south and west of the developed area. The desired wind and fuel conditions will permit a rapid burnout of the unit.

III.A.3.2.1 Impacts of the Preferred Alternative

III.A.3.2.1.1 Impact Analysis

According to the Department of Environmental Quality, Big Bend National Park is designated a Class I air quality area under the 1963 Clean Air Act, as amended (42 U.S.C. 7401 et seq.). Air quality monitoring for western Texas is conducted in El Paso. Big Bend National Park is in attainment with national ambient air quality standards for particulate matter, sulfur dioxide, nitrogen dioxide, ozone, carbon monoxide, and lead.

Air quality would be temporarily degraded by hydrocarbons, nitrogen and sulphur dioxide generated by the prescribed fire on all burn units. However, both emissions and smoke would be rapidly dissipated by air drainage, since air stagnation is rare at Big Bend National Park.

III.A.3.2.1.2 Cumulative Effects

Because impacts to air quality would be short-term and limited in extent no adverse cumulative impacts could be identified in the analysis.

III.A.3.2.1.3 Conclusion

The preferred alternative would result in minor impacts that are local, direct and be of short duration. Smoke will dissipate in one to two days following the burn treatment. Impacts would be minor to negligible. Thus no impairment would occur to air quality as a result of the no action alternative.

III.A.3.2.2 Impacts of Alternative A

III.A.3.2.2.1 Impact Analysis

No impacts to air quality would occur as result Alternative A, the no action alternative.

III.A.3.2.2.2 Cumulative Effects

No cumulative effects would occur as a consequence of Alternative A

III.A.3.2.2.3 Conclusion

Direct local, short-term, negligible to minor adverse impacts to air quality could occur in the event of a wildland fire within the burn unit. No impairment would occur.

III.A.3.3 RGV Wetland-Gambusia Unit

The treatment area is approximately 9 acres. The Rio Grande Village Developed Area is in close proximity to the unit. The campground occupancy is estimated at 10% (20 people) for the time of the burn. Also, day use visitation and employees would bring the estimate up to 60 people occupying the developed area during the predicted burn window. This burn unit contains a fuel loading of grass, brush and trees up to 25 feet in height that are targeted for ignition and consumption. Fuel breaks have been established and the debris from creation of the fuel breaks has been stacked to enhance quick ignition and provide a ladder to the brush canopy. Prescription wind direction and wind speed conditions desired for the achievement of objectives will carry unit disperse smoke immediately away from the Rio Grande Village campground and developed area. The desired wind and fuel conditions will permit a rapid burnout of the unit. The treatment method will include rapid ignition of each sub-unit to create a quick burnout of the sub-unit. Smoldering fuels will be sought out and piled to permit rapid burnout. Prevailing winds are generally from a southeasterly direction. These winds would affect the developed area during any prolong burnout of the heavy fuels.

III.A.3.3.1 Impacts of the Preferred Alternative

III.A.3.3.1.1 Impact Analysis

According to the Department of Environmental Quality, Big Bend National Park is designated a Class I air quality area under the 1963 Clean Air Act, as amended (42 U.S.C. 7401 et seq.). Air quality monitoring for western Texas is conducted in El Paso. Big Bend National Park is in attainment with national ambient air quality standards for particulate matter, sulfur dioxide, nitrogen dioxide, ozone, carbon monoxide, and lead.

Air quality would be temporarily degraded by hydrocarbons, nitrogen and sulphur dioxide generated by the prescribed fire on all burn units. However, both emissions and smoke would be rapidly dissipated by air drainage, since air stagnation is rare at Big Bend National Park.

III.A.3.3.1.2 Cumulative Effects

Because impacts to air quality would be short-term and limited in extent no adverse cumulative impacts could be identified in the analysis.

III.A.3.3.1.3 Conclusion

Minor impacts to air quality would occur from the Preferred Action Alternative that would be local, direct and of short duration. Smoke would dissipate in one to two days following the burn treatment. No impairment would occur to air quality as a result of the no action alternative.

III.A.3.3.2 Impacts of Alternative A

III.A.3.3.2.1 Impact Analysis

No impacts to air quality would occur as result Alternative A, the no action alternative.

III.A.3.3.2.2 Cumulative Effects

No cumulative effects would occur as a consequence of Alternative A

III.A.3.3.2.3 Conclusion

Direct local, short-term, negligible to minor adverse impacts to air quality could occur in the event of a wildland fire within the burn unit. No impairment would occur.

III.A.3.4 Tamarisk Pile Units

The treatment area is approximately 4 acres of 40 separate piles. The Rio Grande Village Developed Area is in close proximately to the unit, but it is also upwind of the burn unit. The campground occupancy is estimated at 10% (20 people) for the time of the burn. Also, day use visitation and employees would bring the estimate up to 60 people occupying the developed area during the predicted burn window. This burn unit contains a fuel loading of log/limb piles up to 8 feet in height and 30 feet in diameter that are targeted for ignition and consumption. The piles have been stacked to enhance quick ignition. Prevailing winds are generally from a southeasterly direction. These winds will carry the smoke and emissions away from developed area during the prolong burnout of the heavy fuels. Smoldering fuels will be sought out and piled to permit rapid burnout. Prescription wind direction and wind speed conditions desired for the achievement of objectives will carry unit smoke and emissions away from the Rio Grande Village campground and developed area. The desired wind and fuel conditions will permit a rapid burnout of the unit. The treatment method will include rapid ignition of each sub-unit to create a quick burnout of the sub-unit.

III.A.3.4.1 Impacts of the Preferred Alternative

III.A.3.4.1.1 Impact Analysis

According to the Department of Environmental Quality, Big Bend National Park is designated a Class I air quality area under the 1963 Clean Air Act, as amended (42 U.S.C. 7401 et seq.). Air quality monitoring for western Texas is conducted in El Paso. Big Bend National Park is in attainment with national ambient air quality standards for particulate matter, sulfur dioxide, nitrogen dioxide, ozone, carbon monoxide, and lead.

Air quality would be temporarily degraded by hydrocarbons, nitrogen and sulphur dioxide generated by the prescribed fire on all burn units. However, both emissions and smoke would be rapidly dissipated by air drainage, since air stagnation is rare at Big Bend National Park.

III.A.3.4.1.2 Cumulative Effects

Because impacts to air quality would be short-term and limited in extent no adverse cumulative impacts could be identified in the analysis.

III.A.3.4.1.3 Conclusion

Effects of tamarisk pile burning would be direct with some adverse, negligible to minor impacts local in extent and of short duration. No impairment would occur to air quality as a result of the preferred alternative.

III.A.3.4.2 Impacts of Alternative A

III.A.3.4.2.1 Impact Analysis

No impacts to air quality would occur as result Alternative A, the no action alternative.

III.A.3.4.2.2 Cumulative Effects

No cumulative effects would occur as a consequence of Alternative A

III.A.3.4.2.3 Conclusion

Direct local, short-term, negligible to minor adverse impacts to air quality could occur in the unlikely event of a wildland fire within the burn unit. No impairment would occur.

III.B Cultural, Archeological and Historical Resources

III.B.1 Methods

This section describes the environmental consequences on cultural, archeological and historical resources associated with the preferred action, Alternative B, and the no action alternative, Alternative A. This section presents the regulations and policy for management, and then describes the effected environment for each unit, followed by the survey methods impact analysis, cumulative effects, and conclusions for the preferred action alternative, and the no action alternative.

The analysis includes a brief description of the affected environment and an evaluation of effects. The impact analysis involved the following steps:

- Identify the area that would be impacted.
- Compare the area of potential impact with the resources that are present.
- Identify the intensity, context, duration (short- or long-term), and type (direct or indirect) of effect, both as a result of this action and from a cumulative effects perspective. Identify whether effects would be beneficial or adverse. The criteria used to define the intensity of impacts associated with the analyses are presented in Table 5.
- Identify mitigation measures that may be employed to offset potential adverse impacts.

The impact analyses were based on professional judgment using information provided by park staff, relevant references and technical literature, and subject matter experts.

III.B.2 Regulations and Policy

The National Historic Preservation Act, as amended in 1992 (16 USC 470 et seq.); the National Environmental Policy Act; and the National Park Service's Cultural Resource Management Guideline (1994), Management Policies (2001), and NEPA Compliance Guideline (1982), require the consideration of impacts on cultural resources listed on or eligible for listing on the National Register of Historic Places. The Native American Graves Protection and Repatriation Act (NAGPRA) of 1990 (25 USC 3001) requires specific actions when Native American human remains, funerary objects, sacred objects, and objects of cultural patrimony are excavated or discovered on federal lands.

The Council on Environmental Quality (CEQ) regulations, which implement the NEPA act, requires assessment of cumulative impacts in the decision-making process for federal projects. Cumulative impacts are defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions" (40 CFR 1508.7). Cumulative impacts are considered for both the no-action and proposed action alternatives.

III.B.3 Effected Environment

III.B.3.1 Southeast Rim

III.B.3.1.1 Survey Method

The Area of Potential Effect (APE) for this project was originally defined by the park Fire Management Officer (FMO) as an area enclosed on three sides by the South Rim Trail, East Rim Trail, and Boot Canyon Trail (Figure 3). The north side was defined by a section of the North Rim Trail, the Townsend Point escarpment, and a ridge descending from Townsend Point to the Juniper Canyon Trail where it followed the latter to its junction with the Boot Canyon Trail. This area received a 100% pedestrian survey in June 1999 under a contract administered by Big Bend National Park. The contract was with the Sul Ross State University Center for Big Bend Studies who provided William A. Cloud as Project Archeologist. The fieldwork was carried out by a crew consisting of personnel from the National Park Service, lead by the Project Archeologist. Park Archeologist Thomas C. Alex was an archeological consultant on the project. All cultural resource surveys met the Secretary of the Interior's Standards for Archeology and Historic Preservation.

The park FMO added two small areas to the APE that were surveyed in April 2000 by Park Archeologist Alex and Archeological Technician Donald W. Corrick. The first addition was a triangular shaped area extending from the aforementioned East Rim Trail to the extreme point of land projecting east from the trail to the rim edge. It was bound on the north and southeast sides by escarpments overlooking Juniper Canyon on the north and the Sierra Quemada on the southeast. The second addition was on the north end of the original APE and was an acutely triangular area with its apex at the extreme northwest end of Townsend Point and its opposing side on the Juniper

Canyon Trail. The southwest side of this triangle was the ridge descending from Townsend Point discussed in the previous paragraph. The east side of this triangle was the ridge forming the divide between Boot and Juniper Canyons.

The park FMO added an additional area to serve as a fire containment line between the South and East Rim Trails and the rim escarpment itself. Park Archeologist Alex and Archeological Technician Donald W. Corrick conducted part of this cultural resource survey in October 2000 and finished it in late November 2000. The survey required searches between the trails and the rim escarpment, as well as at the base of the rimrock for rockshelters that may be affected if fire does burn to the rim edge and burning debris falls over the edge. Because wind patterns along the cliff edge are very unpredictable, fire falling onto the slope at the base of the rim could flare up and burn into the rockshelter openings. Rockshelters provide a dry, stable environment capable of preserving perishable artifacts such as basketry, braided cordage, netting, sandals, and wood and bone tools. The objects are exceedingly rare yet provide the most scientifically significant data on prehistoric lifeways. Sheltered sites were used by historic sheepherders and often contain the remains of late 19th and early 20th century historic period objects made of leather, cloth, rope, or other perishable material. On November 10, 1986, Alex inspected two overhanging ledges below the Southeast Rim and found them to contain no exposed cultural materials. Alex and Corrick reinspected these and others during their November 2000 visit and observed no exposed cultural material.

III.B.3.1.2 Cultural Resources in the Area of Potential Effect (APE)

Cultural resource surveys identified nine precontact sites, one historic ranching feature, and one multicomponent site having both precontact and historic features. The significance of all resources was evaluated for eligibility for listing in the National Register of Historic Places. No Ethnographic Resources or American Indian Religious Sites were identified in the APE and these resource types will not be discussed further.

III.B.3.1.2.1 Archeological Resources

Nine precontact sites (BIBE-169, BIBE-0873, BIBE-1463, BIBE-1052, BIBE-1050, BIBE-1464, BIBE-1465, BIBE-1054, and BIBE-943) were found during cultural resource surveys. Five of these (BIBE-1050, BIBE-1464, BIBE-1465, BIBE-1054, and BIBE-943) were determined not eligible for the National Register. Four sites (BIBE-169, BIBE-0873, BIBE-1463, and BIBE-1052) were considered eligible for the National Register under Criterion D, the potential to yield scientifically important information. These four eligible sites should be protected by avoidance. Two eligible sites (BIBE-0873 and BIBE-1052) are immediately outside the APE, but the site perimeter contacts the proposed burn perimeter where fire could feasibly creep into them, and avoidance was considered the appropriate protective treatment (Cloud 1999; Alex 2000).

III.B.3.1.2.2 Historic Resources and Cultural Landscapes

Cultural resource surveys identified one historic ranching feature (Wilson Ranch High Chisos Pasture fenceline) and one multicomponent site (BIBE-169 mentioned above) having both precontact and historic features. Eleven cultural landscapes have been identified for the park and the APE occurs in one, the Homer Wilson Ranch. Homer Wilson constructed a unique “panther-proof” fence around much of his 28,000-acre ranch (Casey 1969). He constructed cross fences dividing his ranch into six pastures. The Wilson Ranch High Chisos Pasture included the Boot Canyon-East Rim area and was enclosed by the fenceline recorded on Townsend Point. Most of the Wilson Ranch fencing was removed during the first two decades of the park’s existence, and preservation of this remnant is considered an appropriate treatment. Site BIBE-169 is a small rockshelter overlooking the floor of Boot Canyon where Homer Wilson constructed a dam to provide water for livestock. The shelter contains historic period artifacts left by his sheepherders who used the shelter while tending flocks as well as containing precontact deposits. Avoidance of damage to this site is considered an appropriate protective treatment (Smith 2000). .

III.B.3.1.3 Impacts of the Preferred Alternative

III.B.3.1.3.1 Impact Analysis

Fire effects on cultural resources have been well documented, especially in recent years (Jones 2000). Surface lithic artifacts can be damaged by both high-intensity and long-duration fire. Site ground cover (fuel loading and fuel type) determines the potential damage accrued during a fire event. Sites having few surface artifacts or low densities of stone artifacts are considered least significant from the standpoint of fire damage. Sites having a high density of artifacts exposed on the ground surface are considered susceptible to fire damage when dense grass covers the surface. Shallowly buried artifacts are considered threatened when ground cover includes a layer of duff (leaf litter) that concentrates long-duration heat. Subsurface features such as hearths, middens, fiber bedding, grass-lined storage pits, etc. can be damaged if fire creeps down the stem of woody plants and burns underground. Significant damage can occur when fire burns into the root system where it can smolder for long periods as it follows root channels. Within an archeological site, below-ground burning adds charcoal and ash to hearth and midden features, altering the potential for radiometric dating of the site. In the case of the High Chisos rim area, the final containment line for prescribed fire is the cliff edge itself. Should burning debris fall over the cliff

edge it can fall to the cliff base where flare-ups can burn into rockshelters along the cliff base. Rockshelters often preserve perishable artifacts such as basketry, woven matting, braided fiber cordage, sandals, wooden tools, etc. These are particularly susceptible to damage by fire. Coincidentally, rockshelters containing perishable material are the most significant for their potential to yield scientifically significant archeological information. Protection of these sites is imperative (Table 9).

In the case of above ground fence line, steel wire is not susceptible to fire damage, but the supporting posts or trees are. Blacklines can be burned around trees and posts that support wire fencing to avoid destruction of important historic characteristics. The method of fence construction is considered important historic information and portions of the fence that illustrate well the method of construction should be preserved. Should preservation through avoidance not be possible, documentation of the structures must be done prior to the undertaking. Documentation must follow standards established by the Secretary of the Interior and the Historic American Building Survey (HABS).

To preserve significant cultural resources, the most appropriate treatment is to avoid the site altogether. Open sites and rockshelters will be protected by burning a "blackline" buffer around the site perimeter sufficient to reasonably prevent fire from creeping into the site. Should avoidance not be possible, mitigation of adverse effects is required. Site mapping, archeological excavation of exposed features, and collection of surface artifacts must be done to recover important site information prior to the undertaking. Because mitigation costs exceed the budget available for this undertaking, avoidance is the preferred treatment.

Table 5. Effects on Cultural Resources, Southeast Rim prescribed burn

Resource	LCS, CSI, ASMIS #	Level of Significance	Action/ Treatment	Effect	Mitigation	Remarks
Shoeless Shelter	BIBE-169 41BS1446	Eligible – Criterion D	Black-line site perimeter below talus line & above shelter overhang	NE	Avoidance	Surface artifacts exposed
Trail Midden	BIBE-0873 41BS1447	Eligible – Criterion D	Black-line site perimeter	NE	Avoidance	Intense heat potential; high surface artifact density
Creekside Midden	BIBE-1463 41BS1449	Eligible – Criterion D	Black-line site perimeter	NE	Avoidance	Intense heat potential; high surface artifact density
Pitted Wall Shelter	BIBE-1052	Eligible – Criterion D	Prevent burning debris from falling over rim	NE	Avoidance	Shelter floor is devoid of fuel or exposed perishable artifacts; talus may contain artifacts
Townsend's Toe	BIBE-1050 41BS1448	Not eligible	Allow fire across site	NAE	No mitigation	Low surface artifact density exposed
High flat	BIBE-1464 41BS1450	Not eligible	Allow fire across site	NAE	No mitigation	Low surface artifact density exposed
Lost Bead Site	BIBE-1465 41BS1451	Not eligible	Allow fire across site	NAE	No mitigation	Sparse fuel cover; low surface artifact density
East Rim Rhyolite Quarry	BIBE-1054	Not eligible	Allow fire across site	NAE	No mitigation	Site is exposed bedrock lacking fuels
Diving Board Rock	BIBE-943 41BS932	Not Eligible	Allow fire across site	NAE	No mitigation	Low artifact density

Resource	LCS, CSI, ASMIS #	Level of Significance	Action/ Treatment	Effect	Mitigation	Remarks
Wilson Ranch High Chisos Pasture fence line	Homer Wilson Ranch Cultural Landscape	Potentially eligible as a contributing feature to the cultural landscape	Black line around supporting trees; allow fire through wire spans	NAE	Avoidance	Damage/ destruction of fence wire supports; flashy fuel w/ low duration heat in wire spans

* NE=No Effect; NAE=No Adverse Effect; AE=Adverse Effect

III.B.3.1.3.2 Cumulative Effects

No cumulative effects are anticipated to cultural resources. Sites that could be adversely affected by fire would be mitigated primarily by avoidance, that is by not allowing prescribed fire to cross the sites. These sites would, in all likelihood, continue to be avoided if the area is to be retreated with fire.

Sites having been identified as not effected or not adversely effected by fire will be minimally affected by recurring fires. It must be noted that sites in which fire is capable of crossing, may have historically burned on several occasions and thus these sites now express the cumulative effects of such fires. These fires were in all likelihood low intensity fires. How frequent, high intensity fires occurred and their effects are largely unknown. Given the low intensity of the prescribed fire for the Southeast Rim, the cumulative effects of additional fires across these sites would be benign.

III.B.3.1.3.3 Conclusion

Effects of prescribed fire on sites on the Southeast Rim would range from no effect to no adverse effects. Thus impacts of Alternative B, the preferred alternative would not impair cultural resources.

III.B.3.1.4 Impacts of Alternative A

III.B.3.1.4.1 Impact Analysis

No impacts to cultural resources would occur as a result of Alternative A, the no action alternative.

III.B.3.1.4.2 Cumulative Effects

The cumulative effects could occur to sites having significant vegetation growth, particularly in the event of a wildland fire. These sites could experience adverse impacts either from heat damage or erosion damage.

III.B.3.1.4.3 Conclusion

Cumulative impacts to cultural resources from vegetation accumulation could result in adverse effects to cultural sites, particularly in the event of a wildland fire. These effects could be indirect, like erosion damaged caused by the fire, or direct effects from excessive heating of artifacts or charcoal contamination. It may be desirable that site specific treatments, other than prescribed fire, be analyzed to address potential adverse effects of fire to susceptible sites.

III.B.3.2 Comanche Draw

III.B.3.2.1 Survey Methods

The Area of Potential Effect (APE) for this project consists of about 537 acres of open desert shrubland occupying the valley floor between the Sierra del Carmen and the Rosillos Mountains.

The area was surveyed in conjunction with the Comprehensive Archeological Survey during the 1995 fall field season. This intensive survey was carried out under a cooperative agreement between the NPS and Sul Ross State University Center for Big Bend Studies. William A. Cloud was Project Archeologist. Park Archeologist Thomas C. Alex was an archeological consultant on the project. Additional fieldwork to identify fire threats was carried out by Alex during the months of November 2000 and April 2001. The cultural resource surveys met the Secretary of the Interior's Standards for Archeology and Historic Preservation.

Cultural resource surveys identified 14 precontact sites and one cultural landscape. The significance of all resources was evaluated at the park level for eligibility for listing in the National Register of Historic Places. Consultation with the Texas SHPO must include evaluation of and concurrence with the NPS determination. No Ethnographic Resources or American Indian Religious Sites were identified in the APE and these resource types will not be discussed further.

III.B.3.2.2 Archeological Resources

Fourteen precontact sites (BIBE-1122, BIBE-1123, BIBE-1124, BIBE-1125, BIBE-1127, BIBE-1128, BIBE-1132, BIBE-1133, BIBE-1138, BIBE-1152, BIBE-1153, BIBE-1156, BIBE-1157, and BIBE-1158) were found during cultural resource surveys. All are prehistoric campsites ranging in size and complexity, from a single stone paved hearth and no associated artifacts, to having 67 hearths and artifacts representing occupations spanning Early Archaic to Late Prehistoric (6,500 B.C. to A.D 1,500). Periods. Four sites (BIBE-1122, BIBE-1124, BIBE-38, and BIBE-1152) were determined at the park level to be individually eligible for the National Register under Criterion D, the potential to yield scientifically important information. The other ten sites were determined at the park level to be eligible for the National Register under Criterion D as contributing to a multiple property nomination. The Texas SHPO must review the NPS determinations and concur or negotiate on eligibility issues for each of these sites.

Mitigation of fire effects was determined unnecessary at sites BIBE-1125, BIBE-1127, BIBE-1128, and BIBE-1158. The sites either have sparse vegetative cover that would not carry fire across the site surface, or because a protective natural distance exists between the site perimeter and burnable vegetation. The other ten sites can be protected either by manual reduction or black lining fuels along the site perimeter and avoidance. Sites BIBE-1123, BIBE-1127, and BIBE-1158 are immediately outside the APE, but the site perimeter contacts the proposed burn perimeter where fire could feasibly creep into them, and avoidance was considered the appropriate protective treatment (Alex 2000).

III.B.3.2.3 Historic Resources and Cultural Landscapes

The 1999 Cultural Landscape Inventory identified eleven major landscapes for the park, eight of which are listed on the National Register. The Comanche Trail is listed as one of the eleven major cultural landscapes, but has not been nominated or listed on the National Register, nor has an official determination of eligibility been done between the NPS and the Texas SHPO. Consultation with the Comanche tribe is a necessary part of that determination.

The Comanche Trail Cultural Landscape boundaries are defined by the linear nature of the trail, and the viewshed and occupation sites along the trail. Archeological study has yet to determine whether any of the sites listed above are culturally associated with the Comanche use of the trail landscape. The physical characteristic defining the trail is a broad linear swath of parallel tracks caused by riders running abreast on horseback and pulling strings of horses. These tracks occasionally meander back and forth across each other sometimes giving the appearance of a braided stream channel. Over time, the tracks capture rain runoff and eventually become entrenched as rills and gullies. Vegetative growth increases in response to the increased ground water infiltration along these tracks and impedes further erosion.

The original road between the towns of Marathon and Boquillas, Texas, constitutes a later historical component of the cultural landscape. The road relates historically to the early settlement and economic development of the southern Big Bend region in Brewster County.

The old roadbed parallels the Comanche Trail and is apparent in the soft, highly erodable Tornillo Soil of the valley floor. Remnants can be clearly seen at several points within the Area of Potential Effect (APE) and are evident as long and straight, linear depressions. Where the road has captured cross-drainage and sheet flow rainfall, the old roadbed has become a gully entrenched to a depth of one to two meters. Vegetative growth is similarly increased due to the concentration of water along this landscape feature. In places, brush and grass impedes the flow of rainfall runoff and slows the erosion process.

Vegetation communities, individual plants, or groupings of vegetation are considered integral to cultural landscapes. At this time, no vegetative component has been defined for the Comanche Trail Cultural Landscape and no vegetation restoration plan exists for this landscape. Considering the alteration of the landscape by grazing impacts occurring between 1880 and 1944, the composition of the vegetative community during the period of historical significance (Comanche presence) is undetermined.

III.B.3.2.4 Impacts of the Preferred Alternative

III.B.3.2.4.1 Impact Analysis

Fire effects on cultural resources have been well documented, especially in recent years (Jones 2000). Surface lithic artifacts can be damaged by both high-intensity and long-duration fire. Site ground cover (fuel loading and fuel type) determines the potential damage accrued during a fire event. Sites having few surface artifacts or low densities of stone artifacts are considered least significant from the standpoint of fire damage. Sites having a high density of artifacts exposed on the ground surface are considered susceptible to fire damage when dense grass covers the surface. Shallowly buried artifacts are considered threatened when ground cover includes a layer of duff (leaf litter) that concentrates long-duration heat. Subsurface features such as hearths, middens, fiber bedding, grass-lined storage pits, etc. can be damaged if fire creeps down the stem of woody plants and burns

underground. Significant damage can occur when fire burns into the root system where it can smolder for long periods as it follows root channels. Within an archeological site, below-ground burning adds charcoal and ash to hearth and midden features, altering the potential for radiometric dating of the site.

Use of prescribed fire on this cultural landscape should be done selectively and judiciously to avoid exacerbating the existing erosion potential. Management prescribed fire should be tailored to not cause irreversible changes in significant landscape features. It is important to avoid loss of the defining characteristics of the landscape, thus adversely affecting the ability of the landscape to convey its significance.

Table 6. Effects on Cultural Resources, Comanche Draw prescribed burn.

Resource	LCS, CSI, ASMIS #	Level of Significance	Action/ Treatment	*Effect	Mitigation	Remarks
Comanche Trail Cultural Landscape	Unassigned	Eligible Cultural Landscape	Avoid burning vegetation that impedes the flow of runoff	NE	Avoid increased erosion potential	Avoid causing increased erosion
Screaming Rabbit Site	BIBE-1122	Individually eligible; Criterion D	Do not ignite on site or along site perimeter	NE	Avoidance	Significant features to be preserved uncontaminated
Relief Ridge Site	BIBE-1123	Multiple property; Criterion D	Do not ignite on east and south perimeter of site	NE	Avoidance	Significant features to be preserved uncontaminated
Howling Moon Site	BIBE-1124	Individually eligible; Criterion D	Do not ignite on site or along site perimeter	NE	Avoidance	Significant features to be preserved uncontaminated
Late-in-the-Day Site	BIBE-1125	Multiple property; Criterion D	Allow fire across site	NAE	No mitigation	No threat; dismembered feature is 30m from nearest burnable vegetation
Swale Ridge Site	BIBE-1127	Multiple property; Criterion D	Allow fire across site	NAE	No mitigation	No threat; dismembered feature w/ no diagnostic association
Red Coyote Site	BIBE-1128	Multiple property; Criterion D	Allow fire across site	NAE	No mitigation	No threat; Low research value
Brain Drain Site	BIBE-1132	Multiple property; Criterion D	Flag significant feature and avoid	NE	Avoidance	Significant features to be preserved uncontaminated
Homeward Bound Site	BIBE-1133	Multiple property; Criterion D	Site difficult to locate; Flag feature and avoid	NE	Avoidance	Significant features to be preserved uncontaminated
Long Shot Site	BIBE-1138	Individually eligible; Criterion D	Avoid ignition on west perimeter of site	NE	Avoidance	Significant features to be preserved uncontaminated
Racing Lizard Site	BIBE-1152	Individually eligible; Criterion D	Avoid ignition on east and northeast perimeter of site	NE	Avoidance	Significant features to be preserved uncontaminated
The Flea Site	BIBE-1153	Multiple property; Criterion D	Flag feature and avoid	NE	Avoidance	Significant features to be preserved uncontaminated

Resource	LCS, CSI, ASMIS #	Level of Significance	Action/ Treatment	*Effect	Mitigation	Remarks
Thicket View Site	BIBE-1156	Multiple property; Criterion D	No burning on site; Black-line site perimeter	NE	Avoidance	Significant features to be preserved uncontaminated
Comet Tail Site	BIBE-1157	Multiple property; Criterion D	Avoid ignition on north and west perimeter of site	NE	Avoidance	Significant features to be preserved uncontaminated
Basin View Site	BIBE-1158	Multiple property; Criterion D	Allow fire across site	NAE	No mitigation	Sparse vegetation will not carry fire across site features

* NE=No Effect; NAE=No Adverse Effect; AE=Adverse Effect

III.B.3.2.4.2 Cumulative Effects

No cumulative effects are anticipated to cultural resources. Sites that could be adversely affected by fire would be mitigated primarily by avoidance, that is by not allowing prescribed fire to cross the sites. These sites would, in all likelihood, continue to be avoided if the area is to be retreated with fire.

Sites having been identified as not effected or not adversely effected by fire will be minimally affected by recurring fires. It must be noted that sites in which fire is capable of crossing, may have historically burned on several occasions and thus these sites now express the cumulative effects of such fires. These fires were largely low intensity fires. How frequent, high intensity fires occurred and their effects are largely unknown. Given the low intensity of the prescribed fire for Comanche Draw, the cumulative effects of additional fires across these sites would be benign.

III.B.3.2.4.3 Conclusion

Effects of prescribed fire on sites on Comanche Draw would range from no effect to no adverse effects. Thus impacts of Alternative B, the preferred alternative, would not impair cultural resources.

III.B.3.2.5 Impacts of Alternative A

III.B.3.2.5.1 Impact Analysis

No impacts to cultural resources would occur as a result Alternative A, the no action alternative.

III.B.3.2.5.2 Cumulative Effects

The cumulative effects could occur to sites having significant vegetation growth, particularly in the event of a wildland fire. These sites occur in discrete patches in highly discontinuous fuels and are not vulnerable to fires that may start “off-site”. These sites could experience adverse impacts either from heat damage or erosion damage from wildland fires that start on-site.

III.B.3.2.5.3 Conclusion

Cumulative impacts to cultural resources from vegetation accumulation could result in adverse effects to cultural sites, particularly in the event of a wildland fire. These could be indirect effects like erosion damaged caused by wildland fire, or direct effects from of excessive heating of artifacts or charcoal contamination. It may be desirable that site specific treatments other than prescribed fire be analyzed to address potential adverse effects of fire to susceptible sites.

III.B.3.3 RGV Wetland-Gambusia Unit

III.B.3.3.1 Survey Methods

The Area of Potential Effect (APE) for this project consists of about ten acres of floodplain vegetation near the Rio Grande Village Gambusia gaigei (endangered Mosquito Fish) refugium. Park Archeologist, Thomas C. Alex during the months of December 2000 and January 2001, carried out the fieldwork. The cultural resource survey met the Secretary of the Interior’s Standards for Archeology and Historic Preservation.

The vegetation within the area of the prescribed burn covers low lying floodplain deposits between limestone hills. The floodplain is covered by dense mesquite (Prosopis sp.) thickets, marsh grasses, and by dense river cane on the actively flooded terraces near the Rio Grande. Theadjacent hills and ridges are composed of Santa Elena Formation limestone bedrock that is moderately vegetated by lechuguilla (Agave lechuguilla), false agave

(Hechtia scariosa), sparse grasses, and a variety of cacti species. Prehistoric campsites are commonly found on the floodplain adjacent to active water sources such as the Rio Grande.

The survey required intensive pedestrian searches of the floodplain and surrounding ridges. Fire crews had hand cleared much of the dense mesquite thicket from the floodplain, making inspection of the ground surface possible. The active floodplain of the Rio Grande is covered by a dense stand of giant reed and some native river cane (Arundo donax and Phragmites communis). Penetration of this thicket was impossible. This low-level river terrace is seasonally inundated and silt deposits are frequently reworked by erosion and redeposition, thus the potential for intact and significant archeological resources is very low.

The second terrace above the mean river level is occasionally flooded but has been repeatedly used for human habitation. Sites on this terrace are occasionally covered by overbank flooding which gradually builds silt deposits. The first and second terraces are in the hydrologically dynamic zone where deposits are occasionally stripped away and rebuilt, depending upon the intensity of flood events. Habitation sites on the second terrace can be short lived, or may remain for long periods.

Rockshelters are common in Santa Elena limestone and the survey focused on the cliffs surrounding the proposed burn.

III.B.3.3.2 Cultural Resources in the Area of Potential Effect (APE)

Cultural resource surveys identified two precontact sites (BIBE-1053, BIBE-1055), two 20th century sites (BIBE-1057 and Berkeley Cottage), and one site having both precontact and 20th century occupations (BIBE-1056). The significance of all resources was evaluated for eligibility for listing in the National Register of Historic Places. The entire APE lies within the Boquillas Valley Cultural Landscape. The APE lies at the east end of the Mission 66 component of the landscape. No Ethnographic Resources or American Indian Religious Sites were identified in the APE and these resource types will not be discussed further.

III.B.3.3.2.1 Archeological and Historical Resources

Cultural resources present within or adjacent to the APE include two precontact sites (BIBE-1053, BIBE-1055), one site having both precontact and historic period remains (BIBE-1056), one single component historic period archeological site (BIBE-1057), and one historic period building (Berkeley Cottage). Berkeley Cottage lies completely within the APE.

The RGV-15 Monument Site (BIBE-1053) is a precontact open campsite adjacent to the APE. Sparse vegetative cover should not carry fire across the site.

The Catfish Eddy Rockshelter (BIBE-1055) is an alcove adjacent to the project area. The floor of the shelter is a bedrock ledge from which any floor deposit has been removed by wind erosion. Chipped stone cultural materials on the slope below the shelter are strewn between large boulders and exposures of bedrock where sparse vegetation should not carry fire across the site.

The Graham Ranch House site (BIBE-1056) is situated on sparsely vegetated shallow soil and exposures of limestone bedrock. The most susceptible feature is a natural crevice in the bedrock used as a privy, and later as a trash dump containing early 20th century metal, glass, and ceramic artifacts. The Graham House is eroded to its foundations and no wooden structural elements remain. Sparse vegetative cover should not carry fire across the site.

The site of the De Leon jacal and the Garcia adobe (BIBE-1057) was occupied during the early 1900s by Juanita De Leon and by Remijio & Rosario Garcia. Individually, the site is not considered eligible for the National Register. It may be considered as a contributing feature of the Boquillas Valley Cultural Landscape, pending historical research. The site is located at the edge of the APE. Since abandonment of the site, alluvial soil has washed down from the adjacent slopes and covered remnants of structural foundations and trash dumps, and mesquite has reclaimed much of the site. The De Leon jacal is no longer evident on the ground surface. A few cans and glass shards are scattered over the site. No wooden structural members exist above ground where they would be damaged by fire. Sparse vegetation covers the jacal locale and the plant spacing would not carry intense fire. The proposed burn would have no effect on this resource. A mesquite thicket densely covers the Garcia adobe but no leaf litter ground cover exists to carry a fire. The few pieces of metal debris on the surface should be minimally affected by fire.

Berkeley Cottage is a one-story, two-room stone structure built in the 1930s by B. F. Berkeley, a retired Texas State senator as a vacation cottage on the Rio Grande. The building is adaptively used for employee housing. Vegetation is routinely cleared as a buffer surrounding the house to protect it from fire.

III.B.3.3.2.2 Cultural Landscapes

The 1999 Cultural Landscape Inventory identified eleven major landscapes for the park, eight of which are listed on the National Register. The Boquillas Valley is listed as one of the eleven major cultural landscapes, but has not

been nominated or listed on the National Register, nor has an official determination of eligibility been done between the NPS and the Texas SHPO. The broadly defined landscape extends between Boquillas Canyon and lower Tornillo Creek, following the valley of the Rio Grande.

Two National Register listed properties occur within the landscape: the Hot Springs Historic District at the confluence of Tornillo Creek and the Rio Grande, and Daniels Farm at the west end of the Rio Grande Village development. Barker Lodge was determined eligible for the National Register, but the nomination requires additional information before it is resubmitted to the Keeper of the Register for listing.

The themes associated with the landscape include American Indian occupation (Hot Springs), floodplain agriculture (Daniels Farm and Graham Ranch), mining (Ore Tramway), Mexico-US relations/conflicts (Deemer Store/Graham Ranch House), and the Mission 66 development period. No significant landscape features associated with floodplain farming (the irrigation system and associated structures) are located within the APE. The Graham Ranch House was coincidentally associated with the US border conflict with Mexico when Villistas raided the area in 1916. It is considered a contributing property within the landscape, but individually is ineligible for NR listing.

During the 1950s and early 1960s, the Mission 66 program was carried out within the National Park Service. This program of infrastructure development marked an important phase within the history of the NPS. The NPS is currently studying the Mission 66 period and identifying parks with intact Mission 66 buildings and landscape features. Mission 66 development at Big Bend National Park has been identified as prototypical of the Mission 66 era (Carr 1999). At Rio Grande Village (RGV), Mission 66 development includes buildings and landscape features such as the road system, campground layout, irrigation system, and plantings throughout the RGV developed area. The east end of the Mission 66 road system terminates within the APE. One campsite was originally developed at the road terminus, but was removed by the NPS during late 1980s. The vegetative component of the landscape is undefined and no vegetation management plan has been developed for this cultural landscape.

III.B.3.3.3 Impacts of the Preferred Alternative

III.B.3.3.3.1 Impact Analysis

Fire containment can be accomplished by creating a buffer surrounding the perimeter of the floodplain. This can be done using manual fuel reduction (hand cutting) or by burning a blackline buffer. Two sites (BIBE-1053 and BIBE-1056) are considered eligible for the National Register. BIBE-1056 is considered significant as a contributing element in the Boquillas Valley Cultural Landscape. Sites BIBE-1053, BIBE-1055, and BIBE-1056 occur adjacent to and outside of the burn perimeter. Sparse vegetative cover on each site prevents the fire from escaping and crossing the sites. Significant Historic Period remnants at BIBE-1057 will be unaffected by fire burning over the site surface (Table 6). Berkeley Cottage is surrounded by an open area sufficient to prevent low intensity fire from crossing to the building. However, to prevent incidental damage from fire activities, hand cutting or burning a blackline around the perimeter of the sites adjacent to the burn will increase protection. The vegetative component has not been defined for either the Boquillas Valley or the Mission 66 cultural landscapes. No vegetation plan has been developed for cultural landscapes in the park. Management prescribed fire should be tailored to not cause irreversible changes in significant landscape features. It is important to avoid loss of the defining characteristics of the landscape, thus adversely affecting the ability of the landscape to convey its significance.

Table 7. Effects on Cultural Resources, RGV Wetland-Gambusia Unit burn.

Resource	LCS, CSI, ASMIS #	Level of Significance	Action/ Treatment	Effect	Mitigation	Remarks
Boquillas Valley Cultural Landscape	Unassigned	Local; Criteria A, C, D	Avoid irreversible changes to vegetation patterns	NAE	Avoidance	Vegetative component undefined for this cultural landscape
Mission 66 Cultural Landscape	Unassigned	National; Criterion C	Avoid burning plantings made during Mission 66 era	NAE	Avoidance	Vegetative component undefined for this cultural landscape
Graham Ranch House	BIBE-1056	Eligible; Criterion A	Blackline/hand cutting along perimeter of site/ Avoid burning features on Graham Ranch Site	NE	Avoidance	Historic period artifacts in trash pile/privy located on site perimeter. Low potential to carry fire over site
RGV-15 Monument	BIBE-1053	Eligible – Criterion D	Black-line a buffer between site and floodplain thicket	NE	Avoidance	Sparse fuel cover; Exposed surface features and artifacts
Catfish Eddy Rockshelter	BIBE-1055	Not eligible	Lies outside perimeter	NE	No mitigation	Sparse fuel cover; no exposed features
De Leon/ Garcia Homesite	BIBE-1057	Not eligible	No fireline digging	NE	No mitigation	No exposed architecture
Berkeley Cottage		Not eligible	Black line a perimeter buffer, protect from spot fire	NE	Avoidance	Adaptively used for housing

* NE=No Effect; NAE=No Adverse Effect; AE=Adverse Effect

III.B.3.3.3.2 Cumulative Effects

No cumulative effects are anticipated to cultural resources. Sites that could be adversely affected by fire would be mitigated primarily by avoidance, that is by not allowing prescribed fire to cross the sites. These sites would, in all likelihood, continue to be avoided if the area is to be retreated with fire.

Sites having been identified as not effected or not adversely effected by fire will be minimally affected by recurring fires. It must be noted that sites in which fire is capable of crossing, may have historically burned on several occasions and thus express the cumulative effects of such fires. These fires were largely low intensity fires. How frequent, high intensity fires occurred and their effects are largely unknown. Given the low intensity of the prescribed fire for Comanche Draw, the cumulative effects of additional fires across these sites would be benign.

III.B.3.3.3.3 Conclusion

Effects of prescribed fire on sites on the RGV Wetland – Gambusia Unit would range from no effect to no adverse effects. Thus impacts of Alternative B, the preferred alternative, would not impair cultural resources.

III.B.3.3.4 Impacts of Alternative A

III.B.3.3.4.1 Impact Analysis

No impacts to cultural resources would occur as a result of Alternative A, the no action alternative.

III.B.3.3.4.2 Cumulative Effects

The cumulative effects could occur to sites having significant vegetation growth, particularly in the event of a wildland fire. These sites could experience adverse impacts either from heat damage or erosion damage.

Cumulative impacts to cultural resources from vegetation accumulation could result in adverse effects to cultural sites, particularly in the event of a wildland fire. These effects could be indirect, like erosion damaged caused by the fire, or direct effects from of excessive heating of artifacts or charcoal contamination. It may be desirable that site specific treatments, other than prescribed fire, be analyzed to address potential adverse effects of fire to susceptible sites.

III.B.3.3.4.3 Conclusion

Cumulative impacts to cultural resources from vegetation accumulation could result in adverse effects to cultural sites, particularly in the event of a wildland fire. These effects could be indirect, like erosion damaged caused by the fire, or direct effects from of excessive heating of artifacts or charcoal contamination. It may be desirable that site specific treatments, other than prescribed fire, be analyzed to address potential adverse effects of fire to susceptible sites.

III.B.3.4 Tamarisk Piles Unit

III.B.3.4.1 Survey Methods

The Area of Potential Effect (APE) involves the Rio Grande Village developed area. All tamarisk piles at this area are located in the Rio Grande floodplain. The floodplain extends from the Rio Grande northward and is surrounded by limestone hills. The majority of tamarisk piles are concentrated along the main irrigation feeder ditch between the settling ponds and the residential area. Five piles are located near the Daniels Farm Historic Site area. Six piles are located on the west edge of the wetland burn. One pile is located on the east side of the RGV sewage settling pond.

The fieldwork carried out by Park Archeologist Thomas C. Alex during August 2001 included inspection of each pile relative to known cultural sites. The cultural resource survey met the Secretary of the Interior's Standards for Archeology and Historic Preservation. The survey required intensive pedestrian searches of the floodplain.

The second terrace above the mean river level is occasionally flooded but has been repeatedly used for human habitation. Sites on this terrace are occasionally covered by overbank flooding which gradually builds silt deposits. The first and second terraces are in the hydrologically dynamic zone where deposits are occasionally stripped away and rebuilt, depending upon the intensity of flood events. Habitation sites on the second terrace can be short lived, or may remain for long periods.

III.B.3.4.2 Cultural Resources in the Area of Potential Effect (APE)

The entire APE lies within the Boquillas Valley Cultural Landscape. The Mission 66 component of the landscape is associated with early development of Rio Grande Village, construction of the campground and visitor facilities, and NPS residential area. No Ethnographic Resources or American Indian Religious Sites were identified in the APE and these resource types will not be discussed further.

Six tamarisk piles adjacent to the wetland burn are not located on any of the cultural sites discussed in the wetland burn section of this EA. Burning of these six piles will have no effect on archeological or historical sites and will not be discussed further. The following discussion focuses on piles located elsewhere in Rio Grande Village.

Numerous cultural resource surveys associated with various construction and maintenance projects have been done in the Rio Grande Village area. Background research identified four precontact sites (BIBE00823, BIBE00824, BIBE00825, and BIBE00826) located on the Rio Grande Village floodplain. The Daniels Farm National Register Site is located at the extreme west end of the developed area. The majority of tamarisk piles are located around the periphery of the Mission 66 cultural landscape. The significance of all resources was evaluated for eligibility for listing in the National Register of Historic Places.

III.B.3.4.3 Archeological Resources

The four precontact sites (BIBE00823, BIBE00824, BIBE00825, and BIBE00826) are all open campsites exposed in various stages of erosion on the ground surface. Each is characterized by stone-paved hearths in varying stages of dismemberment, scattered fire-cracked rock, ashy midden soil, and chipped stone artifactual debris. Each has been subjected to decades of relic hunting with few diagnostic artifacts and tool forms remain on the surface. Charcoal found in intact hearth features has potential to yield radiometric ages of site occupation. Extensive excavation may produce buried diagnostic materials indicative of cultural activities that occurred on these sites. Two sites, BIBE00823 and BIBE00824, are considered potentially eligible for the National Register, pending subsurface testing to assess the subsurface integrity of cultural deposits. Sites BIBE00825 and BIBE00826 are located in an area of deflated sandy silt dunes. Hearth features are dismembered and fire-cracked rock is scattered on the surface. Little chipped stone artifactual debris remains. These two sites hold little potential

to yield significant scientific information, and lack sufficient integrity to warrant consideration for the National Register.

One tamarisk pile is located in an arroyo at the western edge of site BIBE00823. There is no contiguous vegetation between the site and the tamarisk pile. The site is sparsely populated with creosote bush and will not be threatened by fire encroachment if the tamarisk pile is burned. No tamarisk piles are located near sites BIBE00824, BIBE00825, or BIBE00826.

III.B.3.4.4 Cultural Landscapes

Boquillas Valley

The 1999 Cultural Landscape Inventory identified eleven major landscapes for the park, eight of which contain buildings that are listed on the National Register. The Boquillas Valley is listed as one of the eleven major cultural landscapes, but has not been nominated or listed on the National Register, nor has an official determination of eligibility been done between the NPS and the Texas SHPO. The broadly defined landscape extends between Boquillas Canyon and lower Tornillo Creek, following the valley of the Rio Grande.

Two National Register listed properties occur within the landscape: the Hot Springs Historic District at the confluence of Tornillo Creek and the Rio Grande, and Daniels Farm at the west end of the Rio Grande Village development. The themes associated with the landscape include American Indian occupation (Hot Springs), floodplain agriculture (Daniels Farm and Graham Ranch), mining (Ore Tramway), Mexico-US relations/conflicts (Deemer Store/Graham Ranch House), and the Mission 66 development period.

One significant landscape feature associated with floodplain farming (the irrigation system and associated structures) is located within the APE. The main feeder ditch between the settling ponds and the residential area forms the northwestern periphery of the Boquillas Valley potential cultural landscape. Twenty-six tamarisk piles are located along this section of irrigation ditch.

Five tamarisk piles are located near the Daniels Farm National Register Site. Four are located on the floodplain below the Daniels Farm House (the principle structure of the site). One pile is located in an arroyo east of the Daniels Farm Hand's Casita.

During the 1950s and early 1960s, the Mission 66 program was carried out within the National Park Service. This program of infrastructure development marked an important phase within the history of the NPS. The NPS is currently studying the Mission 66 period and identifying parks with intact Mission 66 buildings and landscape features. Mission 66 development at Big Bend National Park has been identified as prototypical of the Mission 66 era (Carr 1999). At Rio Grande Village (RGV), Mission 66 development includes buildings and landscape features such as the road system, campground layout, reflection pool, irrigation system, and plantings throughout the RGV developed area. The vegetative component of the landscape is undefined and no vegetation management plan has been developed for this cultural landscape. Vegetation planted during this period of development included cottonwood and sycamore groves and does not include the exotic growth of tamarisk.

III.B.3.4.5 Impacts of the Preferred Alternative

III.B.3.4.5.1 Impact Analysis

Fire containment can be accomplished by creating a buffer surrounding the perimeter of each tamarisk pile, or group of piles. No tamarisk piles are located where they will threaten the irrigation ditches. Vegetation occurring between historic buildings and the tamarisk piles must be thinned to prevent fire from crossing through this vegetation where it would threaten the historic buildings. The vegetative component has not been defined for either the Boquillas Valley or the Mission 66 cultural landscapes. No vegetation plan has been developed for cultural landscapes in the park. Management prescribed fire should be tailored to not cause irreversible changes in significant landscape features. It is important to avoid loss of the defining characteristics of the landscape, thus adversely affecting the ability of the landscape to convey its significance. Since tamarisk was not part of the Mission 66 planting plan, removal of exotic tamarisk will enhance the Mission 66 cultural landscape component.

Table 8. Effects on cultural resources, tamarisk piles.

Resource	LCS, CSI, ASMIS #	Level of Significance	Action/ Treatment	Effect	Mitigation	Remarks
Boquillas Valley Cultural Landscape	Unassigned	Local; Criteria A, C, D	Avoid irreversible changes to vegetation patterns	NAE	Avoidance	Vegetative component undefined for this cultural landscape

Resource	LCS, CSI, ASMIS #	Level of Significance	Action/ Treatment	Effect	Mitigation	Remarks
Mission 66 Cultural Landscape	Unassigned	National; Criterion C	Avoid burning plantings made during Mission 66 era	NAE	Avoidance	Vegetative component undefined for this cultural landscape
Daniels Farm NR Site	LCS 12074 BBH-443	Local; Criteria A & C	Black-line a buffer between site and tamarisk piles; protect membrane roof	NAE	Avoidance	Rubber membrane roof must be protected from falling embers
Daniels Acequia System	LCS 61085 BBH-444	Local; Criteria A & C	No threat from burning tamarisk piles	NE	No mitigation	No burnable materials in irrigation system or related structures
BIBE00823	BIBE00823	Local; Criterion D	None	NE	No mitigation	
BIBE00824	BIBE00824	Local; Criterion D	No associated tamarisk piles	NE	No mitigation	
BIBE00825	BIBE00825	Not eligible	No associated tamarisk piles	NE	No mitigation	
BIBE00826	BIBE00826	Not eligible	No associated tamarisk piles	NE	No mitigation	

* NE=No Effect; NAE=No Adverse Effect; AE=Adverse Effect

III.B.3.4.5.2 Cumulative Effects

No cumulative effects are anticipated to cultural resources. Sites that could be adversely affected by fire would be mitigated primarily by avoidance, that is by not allowing prescribed fire to cross the sites. These sites would, in all likelihood, continue to be avoided if the area is to be retreated with fire.

Sites having been identified as not effected or not adversely effected by fire will be minimally affected by recurring fires. It must be noted that sites in which fire is capable of crossing, may have historically burned on several occasions and thus express the cumulative effects of such fires. These fires were largely low intensity fires. How frequent, high intensity fires occurred and their effects are largely unknown. Given the low intensity of the prescribed fire for the tamarisk piles and their small size, the cumulative effects of additional fires across these sites would be benign.

III.B.3.4.5.3 Conclusion

Effects of burning tamarisks piles to cultural sites on range from no effect to no adverse effects. Thus impacts of Alternative B, the preferred alternative, would not impair cultural resources.

III.B.3.4.6 Impacts of Alternative A

III.B.3.4.6.1 Impact Analysis

No impacts to cultural resources would occur as a result of Alternative A, the no action alternative.

III.B.3.4.6.2 Cumulative Effects

The cumulative effects could occur to sites having significant vegetation growth, particularly in the event of a wildland fire. These sites could experience adverse impacts either from heat damage or erosion damage.

Cumulative impacts to cultural resources from vegetation accumulation could result in adverse effects to cultural sites, particularly in the event of a wildland fire. These effects could be indirect, like erosion damaged caused by the fire, or direct effects from of excessive heating of artifacts or charcoal contamination. It may be desirable that site specific treatments, other than prescribed fire, be analyzed to address potential adverse effects of fire to susceptible sites.

III.B.3.4.6.3 Conclusion

Cumulative impacts to cultural resources from vegetation accumulation could result in adverse effects, particularly in the event of a wildland fire. These effects could be indirect and long term, like erosion damaged

caused by the fire, or direct effects from of excessive heating of artifacts or charcoal contamination. It may be desirable that site specific treatments, other than prescribed fire, be analyzed to address potential adverse effects of fire to susceptible sites.

III.C Vegetation Resources

III.C.1 Methods

This section describes the environmental consequences on vegetation associated with the preferred action, Alternative B, and the no action alternative, Alternative A. This section presents the regulations and policy for management, and then describes the effected environment for each unit, followed by the impact analysis, cumulative effects, and conclusions for the preferred action alternative, and the no action alternative.

The analysis includes a brief description of the affected environment and an evaluation of effects. The impact analysis involved the following steps:

- Identify the area that would be impacted.
- Compare the area of potential impact with the resources that are present.
- Identify the intensity, context, duration (short- or long-term), and type (direct or indirect) of effect, both as a result of this action and from a cumulative effects perspective. Identify whether effects would be beneficial or adverse. The criteria used to define the intensity of impacts associated with the analyses are presented in Table 5.
- Identify mitigation measures that may be employed to offset potential adverse impacts.

The impact analyses were based on professional judgment using information provided by park staff, relevant references and technical literature, and subject matter experts.

III.C.2 Regulations and Policy

The National Environmental Policy Act (NEPA) (1969) calls for an examination of the impacts on all components of affected ecosystems. National Park Service policy is to maintain all the components and processes of naturally evolving park ecosystems, including the natural abundance, diversity, and ecological integrity of plants and animals (NPS Management Policies, 2001).

The Endangered Species Act (1973) requires an examination of impacts on all federally threatened or endangered species. National Park Service policy also requires examination of the impacts on federal candidate species, plants and animals as well as state-listed threatened, endangered, candidate, rare, declining, and sensitive species. There are several rare plant species within the proposed project areas that are evaluated in the EA.

The Council on Environmental Quality (CEQ) regulations, which implement the NEPA act, requires assessment of cumulative impacts in the decision-making process for federal projects. Cumulative impacts are defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions" (40 CFR 1508.7). Cumulative impacts are considered for both the no-action and proposed action alternatives.

III.C.3 Effected Environment

III.C.3.1 Southeast Rim

III.C.3.1.1 Native plant communities

The vegetation of the Southeast Rim Unit can generally be classified into two or three broad community categories (Plumb 1992). Much of the top of the rim is a matrix of Plumb's pinyon-oak-juniper and pinyon-juniper-grass types. Several of the steeper, mostly north-facing slopes within the burn area are categorized by Plumb as pinyon-talus. Similarly, (Moir 1982) considered the bulk of the rim to be "pinyon-juniper savanna", while terming the more sheltered swales and canyons, which the burn perimeter just barely includes on the north and northwest, "canyon cypress forest". Regardless of the classification system used, it is apparent that the burn perimeter includes two fairly distinct ecological types, 1) an upper open forest or savanna, and 2) patches of more mesic forest, often associated with talus, on the northern edge of the perimeter.

The vegetation of the upper rim forest/savanna has been quantitatively described by the installation of 10 fire effects monitoring plots (NPS 1992; Big Bend Fire Effects Monitoring Crew, pers. comm.). The overstory of the

upper rim is largely Mexican pinyon (*Pinus cembroides*) with smaller amounts of juniper species (*Juniperus deppeana*, *J. flaccida*) and grey oak (*Quercus grisea*) interspersed. Canopy closure is generally low. Most sites on the upper rim have well over 30% graminoid cover, with several sites having over 50%. Dominant grasses are bull muhly (*Muhlenbergia emersleyi*) and pinyon ricegrass (*Piptochaetium fimbriatum*), both robust bunchgrasses. Although succulents (*Agave havardiana*) and shrubs (e.g. *Salvia regla, Viguiera stenoloba*) are common, cover of these plants is generally low.

The plant communities of the more mesic slopes on the north side of the burn perimeter have not been recently quantified. In general, canopy closure on these slopes is greater, and grass cover lower, than on the upper rim (J. Sirotnak, pers. obs.). The mesic sites are dominated by pinyon and juniper stands with a greater component of oaks and other woody species, potentially including douglas-fir (*Pseudotsuga menziesii*) and Arizona cypress (*Cupressus arizonica*), than the upper rim. Steep, rocky, forested slopes characterize several old talus slopes on the north flank of the burn unit.

III.C.3.1.2 Sensitive plant taxa

No federally listed threatened or endangered species occur within or near the proposed burn perimeter. Populations of five NPS sensitive plant taxa (Table 3) are located within or immediately on the edge of the burn perimeter (Poole and Carr 2000). Only one of these plants, tall-stemmed paintbrush (*Castilleja elongata*) is federally listed as a candidate species. Populations of two other sensitive species, including candidate species Guadalupe fescue (*Festuca ligulata)* occur within 400 meters of the burn perimeter (Figure 3).

No sensitive plant taxa were encountered during the fire monitoring plot installation on the upper rim. However, the area has not been intensely surveyed. Most rare plant surveys have been conducted only in the proximity of trails. A preliminary assessment of *Festuca ligulata* habitat suitability indicates that this candidate species might be found in the more mesic habitats, especially associated with talus, within the burn perimeter. A more complete habitat suitability assessment and directed field search was conducted for the candidate species *F. ligulata* at its most identifiable stage in the field in the fall of 2001 with no individuals found within the burn area on sites having the most suitable habitat. Another survey will be conducted for the candidate species *C. elongata* during the appropriate flowering period before project initiation. Many of the known populations of sensitive plant species occur near the edge of the burn perimeter, permitting their exclusion from the burn treatment if it is deemed necessary.

Table 9. NPS senstitive plant taxa within or near the proposed Southeast Rim Unit.

Species	TPWD[1] Status	Federal Status	Location with Respect to Burn Perimeter
Agave glomeruliflora	G2Q S2	None	Within, near edge
Aquilegia longissima	None	None	Within, near edge
Castilleja elongata	G2Q S2	Candidate	Within, near edge
Festuca ligulata	G1 S1	Candidate	400 meters outside
Hexalectris spp.	G1,G2 S1,S2	None	Within, near edge
Quercus graciliformis	G1 S1	None	Within
Quercus tardifolia	G1 S1	None	150 meters outside

[1] Texas Parks and Wildlife, Biodiversity Office. G = Global Ranking, S= State Ranking, Q= Taxonomy uncertain. Data from Poole and Carr, 2000.

III.C.3.1.3 Invasive exotic plants

The proposed burn site is remarkably free of exotic plant infestation. Few invasive exotic plants occur within or near the proposed burn. The Boot Cabin area, within 200 meters of the burn perimeter, is moderately infested with horehound (*Marrubium vulgare*), which is a nuisance plant but has not proven highly invasive in undisturbed areas. In recent years, NPS personnel and volunteers have been removing horehound from the area.

III.C.3.1.4 Impacts of the Preferred Alternative

III.C.3.1.4.1 Impact Analysis

The Southeast Rim Unit, as planned, has a high probability of achieving the desired goals of woody fuel reduction and savanna/woodland maintenance. Fire history studies in the Chisos Mountains indicate that historic fire frequency intervals in montane forests and woodlands ranged from 9 to 60 years (Moir 1982). At least ten fires burned in various parts of the high Chisos between 1770 and 1940. Due to the threat of high-intensity stand-

replacing fires, the Chisos Mountains have been a full-suppression fire management zone for the last half-century. Although two significant fires have occurred more recently in the Chisos and foothills, suppression efforts have minimized the role of fire as a ecosystem process in these areas. No fires have occurred in or adjacent to the proposed unit in at least 50 years. The proposed South Rim burn, if completed as planned and within prescription, will be an appropriate re-introduction of fire as a natural ecosystem process in this area.

Although we have little data on fire-effects specific to the savanna and woodland vegetation of the Southeast Rim Unit, many studies have demonstrated the importance of fire in limiting woody growth, maintaining herbaceous cover, and creating the open-canopied condition characteristic of native savannas in general, and of oak-pinyon-juniper savannas in particular. The question of how grasses and trees coexist in woodlands and savannas has been termed the "savanna problem" (Sarmiento 1984). Many studies have concluded that variable-intensity fire events, repeated at various intervals, are necessary in the natural maintenance of these systems (Fuhlendorf and Smeins 1997; Higgins et al. 2000).

The small amount of data that exist for predicting the environmental consequences of the Southeast Rim Unit come from studies following a 1980 wildfire in Laguna Meadows, several kilometers northwest of the proposed burn. Plant communities in the Laguna Meadows fire are sufficiently different from those in the proposed Southeast Rim Unit that comparisons should be made with caution. In burned oak scrub communities (*Quercus intricata*), both total shrub and grass cover decreased after the fire and had not substantially recovered after 30 months. Visual inspection of the site after 20 years reveals that the scrub oak regained dominance and grass cover is fairly low (J. Sirotnak, unpubl. data). In pinyon-juniper woodlands burned in the Laguna Meadows fire, grass cover was less and shrub cover was greater than in unburned areas after 30 months (Wolfenbarger 1994). The Laguna Meadows wildfire occurred after an extended drought. Fire intensities of the proposed burn will probably be lower than the Laguna Meadows fire due to the current fire prescription calling for a burn when fire intensities are expected to be light to moderate.

If the fire is maintained within the planned perimeter, the rare plant populations near the proposed burn will not be affected. Intensive surveys of the burn area will be conducted in previous to ignition, to locate and map rare plants found within the burn perimeter. Any newly found rare plant populations will be excluded from the burn perimeter.

If the prescribed fire threatens to escape control, the protection of rare plant sites, especially Guadalupe fescue in Boot Canyon, will be a high wildfire management priority. Rare plant sites that are unintentionally burned will be evaluated and monitored to determine effects on rare plant populations.

Small amounts of fire line will be constructed for the proposed burn. After the burn, any line constructed will be rehabilitated and revegetated with salvaged plant materials as needed.

III.C.3.1.4.2 Cumulative Effects

The objective of the prescribed burn on the Southeast Rim is to reintroduce an ecological process in order to maintain the present composition and structure of the plant communities of the Southeast Rim. Additional treatments may be necessary to reduce fuel loads that are the cumulative effects of a 100+ years fire free period. The cumulative effects of this prescribed burn and additional burns is to maintain the present status of the woodland and forests of the Southeast Rim.

III.C.3.1.4.3 Conclusions

If carried out according to an approved prescription and contained within established burn perimeters, the proposed burn will have no adverse effects on vegetation. Any impacts will be direct, local and short-term. Although individual plants may be killed, this does not constitute an adverse impact to effected plant populations. The proposed burn will further the goal of hazard fuel reduction and savanna ecosystem maintenance in the High Chisos. The proposed action is unlikely to impair vegetation resources.

III.C.3.1.5 Impacts of the Alternative A

III.C.3.1.5.1 Impact Analysis

Fuel loads would continue to increase. Juniper would continue to invade and possibly displace Mexican pinyon and oak tree species. Seedlings and saplings of all species of trees would continue to become established and add to the potential for large, uncontrolled fire (Moir 1982). The savanna understory would continue to be degraded by invasion of woody species (Higgins et al. 2000). Any human-caused fire or natural ignition would continue to be suppressed. The difficulty of controlling a wildland fire would continue to increase.

III.C.3.1.5.2 Cumulative Effects

Cumulative effects would arise as a result of continued accumulation of fuels on the Southeast Rim. Fuel accumulations could reach levels that could contribute to extreme fire behavior resulting in adverse impacts to vegetation resources.

III.C.3.1.5.3 Conclusions

The no action alternative could increase the probability of extreme fire behavior as a result of continued vegetation accumulation. This type of event would have direct local long-term adverse impacts to the existing woodland and forest of the Southeast Rim. Old growth stands would be impaired and the habitat of endangered plants could be irreversibly altered.

III.C.3.2 Comanche Draw Unit

III.C.3.2.1 Native plant communities

The Comanche Draw burn area consists largely of low-density and low-diversity Chihuahuan Desert shrublands. Patches of dense mesquite (*Prosopis glandulosa*) thicket, with a large component of dead and dying shrubs, occur scattered within several swales in the area. Outside of these areas, dominant shrubs are creosotebush (*Larrea tridentata*), saltbush (*Atriplex canescens*), mariola (*Parthenium incanum*) and tarbush (*Flourensia cernua*). Total grass cover is low. Small patches of grama (*Bouteloua* spp.), burrograss (*Scleropogon brevifolius*), tobosa (*Hilaria mutica*) and *Setaria* spp. occur, mostly in and around the mesquite thickets.

III.C.3.2.2 Sensitive plant taxa

No federally listed or NPS sensitive species occur in or near the proposed burn area (Louie 1996).

III.C.3.2.3 Invasive exotic plants

Johnsongrass (*Sorghum halapense*) is present in many draws near the burn area. Because Johnsongrass responds vigorously to burning and may spread, patches of johnsongrass will be excluded from the burn perimeter.

III.C.3.2.4 Impacts of the Preferred Alternative

III.C.3.2.4.1 Impact Analysis

Fire effects in the Comanche Draw unit will vary widely depending upon local fuel characteristics. In general, the dense mesquite thickets in draws will be more fully affected by the proposed burn than the adjacent desert scrub communities. The sparse desert scrub communities are unlikely to carry fire consistently and are therefore likely to exhibit variable responses to fire, from significant shrub removal to only minor alterations in existing plant community structure (Bock and Bock 1988 November 15-17; Williams 1995). Dense fuels in mesquite thickets will probably lead to higher fire intensities and more shrub top-kill than in the desert scrub, but the net long-term effects of fire in mesquite thickets will be largely determined by mesquite resprouting rates. In extreme cases, vigorous growth by mesquite re-sprouts can eclipse the biomass loss from burned areas within five years (Martin 1983).

It is a generally held tenet that fire can be used to increase grass cover and decrease shrub biomass in Chihuahuan Desert landscapes (Kittams 1972; Meents and Moir 1982; Williams 1995). The proposed Comanche Draw burn might stimulate grass production at the expense of shrubs, but several important caveats must be addressed here.

One reason that the proposed fire might not cause a significant increase in grass cover is that, at present, there is little grass on site from which grass cover can increase. Current cover of graminoids, principally black grama (*Bouteloua eriopoda*) and plains bristlegrass (*Setaria leucopila*) is approximately 3% (NPS, unpublished data). It is possible that the loss of topsoil due to historic hydrologic alterations upstream in Comanche Draw have made the site unfavorable for grasses (C. Purchase, pers. comm.). In this case, the environmental consequences of the proposed burn will be to reduce shrub cover, without the desired concomitant increase in grasses. The historic conversion of many desert grasslands to scrublands, such as probably occurred in Comanche Draw, may be so complete as to negate fire as an effective restoration tool. (Bock and Bock 1988 November 15-17) write "Fires may once have been locally important in controlling Chihuahuan Desert scrubs, but they lost all influence once grazing destroyed the fragile grasslands". Cable (1967) reached a similar conclusion. A study of the effects of two fires (1989, 1992) near Panther Junction in Big Bend National Park supports this observation as well. The only significant short-term change in grass cover observed was a 62% decrease in the cover of chino grama (*Bouteloua ramosa*) five years after the 1989 burn (Williams 1995). No significant increases in grass cover were observed following either burn. A similar result could be expected for the Comanche Draw burn.

Additionally, an increasing number of authors believe that the net response of desert grasses to fire is largely determined by the season of burning and the relative status of soil water rather than by the fire behavior (Humphrey 1974; Gavin 1982; Bock and Bock 1988 November 15-17; Cox et al. 1988 November 15-17; Hernandez 1993; McPherson 1995b; Ibarra-F et al. 1996; Hester et al. 1997; Higgins et al. 2000; Gelo 2001). For example, burning during dry years may decrease, rather than in increase, grass production (Cox et al. 1988 November 15-17; McPherson 1995b). It is likely that the natural, pre-historic fire regime in desert grasslands was

one of warm season, wind-driven fires (Meents and Moir 1982; Moir 1982; McPherson 1995b), and there is evidence that several grass species increase after fires during the mid-growing season (Humphrey 1974; Gavin 1982), and that spring or fall burns are less likely to promote grass increases (Gavin 1982; Cox et al. 1988 November 15-17). The prescription for the Comanche Draw burn calls for a wind driven fire, which should maximize the possibility of grassland restoration. If the prescribed fire occurs in the fall or if significant rains do not follow the fire, several grass species, including tobosa (*Hilaria mutica*) could be negatively affected (Humphrey 1974; Gavin 1982; Bock and Bock 1988 November 15-17).

Johnsongrass (*Sorghum halapense*), an undesirable exotic grass, occurs sporadically in draws near the burn perimeter. Johnsongrass has the potential to increase after fire (Fire Effects Information System, 2001). Patches of this exotic grass will be excluded from the burn and the burn area will be monitored to detect new infestations establishing in the burn area. New infestations will be controlled using standard chemical techniques that have been successful elsewhere in the park.

Vegetation surrounding the burn perimeter is not appreciably different from that which is planned for burning and similar fire effects would be expected, if the burn extends beyond the proposed boundary. If the proposed fire escapes to areas containing johnsongrass, it is likely that this exotic grass will respond vigorously and may spread.

III.C.3.2.4.2 Cumulative Effects

Little is known about the cumulative effects of burning within this or similar systems. The prescription for the burn will be for a relatively cool burn to minimize adverse heating effects as with subsequent burns, that is until enough information is obtained that would dictate that more intense fires are necessary to maintain or enhance the plant community. Fire effects will be monitored to determine the long term effect of this fire.

III.C.3.2.4.3 Conclusions

Because the burn will be carried out with a conservative prescription (a cool fire), impacts to vegetation will be direct, local, short term and adverse. Vegetation cover will decrease short term, but it should approach pre-burn levels in three to five years. No impairment to vegetation resources are expected to occur as a result of this burn.

III.C.3.2.5 Impacts of Alternative A, the No Action Alternative

III.C.3.2.5.1 Impact Analysis

No impacts are anticipated to vegetation as a result of the no action alternative. The plant community will continue on it current trajectory as it responds to continued soil loss and significantly reduce fire frequency. An opportunity to obtain ecological information of the effect of fire would not be realized this hindering effective fire management of these communities.

III.C.3.2.5.2 Cumulative Effect

Cumulative effects will be manifested over time as the vegetation responds to continued soil erosion, loss of native grass and shrubs and exotic plants like Johnsongrass may increase.

III.C.3.2.5.3 Conclusion

No adverse affect will occur to the vegetation in the Comanche Draw unit, thus no impairment to vegetation resources is likely to occur with the no action alternative, Alternative A

III.C.3.3 RGV Wetland-Gambusia Unit

III.C.3.3.1 Native plant communities

The plant communities in the *Gambusia* pond area consist of dense mesquite-dominated thickets in the uplands, grading to more mesic grass-shrublands and stands of giant reed along the Rio Grande. Plumb (Plumb 1992) categorized the proposed burn area as a matrix of "mixed riparian" and "mesquite thicket" vegetation types. In general, this mixture of upland and mesic sites represents one of the more locally variable plant community types in the Big Bend region (Plumb 1992). Where road construction and other barriers to natural hydrology have altered the vegetative community in this area, the NPS has removed roads and is actively restoring, native wetland and mesic grasslands. Restoration methods in this area include seeding and transplanting native grasses, controlling invasive exotic plants, and irrigating to maintain transplants. Several areas that are currently under restoration lie within the proposed burn, notably burn blocks 2 and 3 (Figure 4).

Dominant woody vegetation at this site includes honey mesquite (*Prosopis glandulosa*), catclaw acacia (*Acacia greggii*), Guayacan (*Guaiacum angustifolium*), and persimmon (*Diospyros texana*). The dominant grass in mesic sites is alkali sacoton (*Sporobolus airoides*), with a mixture of other grasses in uplands and pure stands of giant reed (*Arundo donax)* in hydric habitats.

III.C.3.3.2 Sensitive plant taxa

No federally listed or NPS sensitive species occur in or near the proposed burn area (Louie 1996). The nearest populations of NPS sensitive plants (*Bonamia ovalifolia*, *Chamaesyce* spp.) occur near the mouth of Boquillas Canyon, three and a half miles downstream from the proposed burn.

III.C.3.3.3 Invasive exotic plants

Within the proposed burn area, buffelgrass (*Pennisetum ciliare*), a highly invasive African bunchgrass, occurs sporadically (National Park Service 1998). In support of the wetland restoration efforts described above, the NPS is actively suppressing buffelgrass by physical removal of plants and judicious use of herbicide. Few patches of buffelgrass remain in the area. Saltcedar (aka tamarisk, *Tamarix* spp.) was present in the more mesic and hydric sites in the burn area until recent years, when it was largely eradicated by the NPS.

Giant Reed (*Arundo donax*) at present forms a dense monoculture in the sites most proximal to the Rio Grande, especially in burn block 5 (Figure 4).

Bermuda grass (*Cynodon dactylon*), rabbitfoot grass (*Polypogon monspeliensis*), and tree tobacco (*Nicotiana glauca*) also occur in the potential burn area.

III.C.3.3.4 Impacts of the Preferred Alternative

III.C.3.3.4.1 Impact Analysis

The proposed burn will top-kill of western honey mesquite (*Prosopis glandulosa* v. *torreyana*). The removal of closed-canopy mesquite should allow native grasses, which are already well-established, in the area to increase. The removal of overstory mesquite and the expansion of native grasses could significantly advance the goal of restoring wetland conditions at this site. In the short term, the ability of native grasses to respond favorably to fire is determined largely by post-fire precipitation (Bock and Bock 1988 November 15-17). Western honey mesquite has the ability to resprout from dormant subterranean buds after fire. The extent of resprouting may depend upon the intensity of fire, with lower resprout rates occurring after more intense fires. The long-term maintenance of the grassland may necessitate repeated burning. Patches of exotic buffelgrass (*Pennisetum ciliare*), which is generally more tolerant of fire than native grasses (Burgess et al. 1991), are likely to increase after the burn. In order to prevent the invasion of Buffelgrass into burned areas, mechanical and chemical control methods will be used on this site.

If the proposed burn escapes the planned fire area or burns outside of planned prescription, adjacent areas of mesquite thicket and exotic giant reed (*Arundo donax*). Giant reed should respond vigorously to fire and few short or long-term effects will be evident.

III.C.3.3.4.2 Cumulative Effects

The cumulative effects of the proposed burn will open up the site for the reestablishment of native grasses as well enhance the vigor of existing plants. Additional burning may be necessary to maintain grass dominance on the site and retard shrub encroachment.

III.C.3.3.4.3 Conclusions

Direct localized moderate adverse impacts of long duration are expected to occur to undesirable shrubs. Shrubs will recover in the long term (3 to 5 years) without repeated burning treatments. Grasses will receive direct local benefits that can be sustained with repeated burning treatments. Impairment to vegetation resource would not occur as a result of the preferred alternative.

III.C.3.3.5 Impacts of Alternative A

III.C.3.3.5.1 Impact Analysis

No impacts to vegetation are anticipated for the no action alternative, Alternative A. Mesquite would continue to dominate portions of the site.

III.C.3.3.5.2 Cumulative Effects

The cumulative effects of the no action alternative would be that over time mesquite would encroach into restored portions of the RGV Wetland, resulting in a loss of the wetland habitat for the endanger fish, *Gambusia geigai*.

III.C.3.3.5.3 Conclusions

No adverse impacts are anticipated for the no action alternative. There is the potential for mesquite to encroach back into the restored wetland habitat and displace native grasses, which would be a long-term direct moderate to significant adverse impact to native grasses and potential the endangered fish. Immediate impacts, however would not impair vegetation resources.

III.C.3.4 Tamarisk Piles Unit

Native vegetation at in the area of the tamarisk pile burning at Rio Grande Village consist largely of sparse desert vegetation, with the exception of two piles near the river, where the adjacent vegetation is giant cane. Because the spatial extent of the burn piles is small and tamarisk slash was piled largely on already barren areas, little native vegetation is in the affected area. Similarly, although exotic plants may occur near the burns, the burned areas do not include known exotic plant populations.

No federally listed of NPS sensitive plant taxa are known to occur near the burn piles (Louie 1996).

III.C.3.4.1 Impacts of the Preferred Alternative

III.C.3.4.1.1 Impact Analysis

Because only previously cut exotic plant biomass will be burned, no effects upon native vegetation are expected.

III.C.3.4.1.2 Cumulative Effects

Because no live vegetation will be burned no cumulative effects are anticipated. Because the sites are also bare and populations of exotic species are not present burning these sites will not increase the potential for exotic plant establishment.

III.C.3.4.1.3 Conclusions

No impairment to vegetation resources in the tamarisk piles unit will occur as a result of burning tamarisk piles.

III.C.3.4.2 Impacts of Alternative A

III.C.3.4.2.1 Impact Analysis

Because piles are on barren areas no impacts to native vegetation are expected from the no action alternative, Alternative A.

III.C.3.4.2.2 Cumulative Effects

No cumulative effects to native vegetation are expected as a direct result of the no action alternative.

III.C.3.4.2.3 Conclusions

Given the absence of native and exotic vegetation where the tamarisk piles are to be burned the no action alternative would not impair vegetation resources.

III.D Wildlife Resources

III.D.1 Methods

This section describes the environmental consequences on wildlife associated with the preferred action, Alternative B, and the no action alternative, Alternative A. This section presents the regulations and policy for management, and then describes the effected environment for each unit. Once the effected environment has been described for all the units, the impact analysis, cumulative effects, and conclusions will be done for all the units simultaneously for the preferred action alternative, and the no action alternative.

The analysis includes a brief description of the affected environment and an evaluation of effects. The impact analysis involved the following steps:

- Identify the areas that would be impacted.
- Compare the area of potential impact with the resources that are present.
- Identify the intensity, context, duration (short- or long-term), and type (direct or indirect) of effect, both as a result of this action and from a cumulative effects perspective. Identify whether effects would be beneficial or adverse. The criteria used to define the intensity of impacts associated with the analyses are presented in Table 5.
- Identify mitigation measures that may be employed to offset potential adverse impacts.

The impact analyses were based on professional judgment using information provided by park staff, relevant references and technical literature, and subject matter experts.

III.D.2 Regulations and Policy

The National Environmental Policy Act (NEPA) (1969) calls for an examination of the impacts on all components of affected ecosystems. National Park Service policy is to maintain all the components and processes of naturally evolving park ecosystems, including the natural abundance, diversity, and ecological integrity of plants and animals (NPS Management Policies, 2001).

The Endangered Species Act (1973) requires an examination of impacts on all federally threatened or endangered species. National Park Service policy also requires examination of the impacts on federal candidate species, plants and animals as well as state-listed threatened, endangered, candidate, rare, declining, and sensitive species.

The Council on Environmental Quality (CEQ) regulations, which implement the NEPA act, requires assessment of cumulative impacts in the decision-making process for federal projects. Cumulative impacts are defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions" (40 CFR 1508.7). Cumulative impacts are considered for both the no-action and proposed action alternatives.

III.D.3 Effected Environment

III.D.3.1 Southeast Rim

III.D.3.1.1 Native Wildlife

Wildife of the Southeast Rim are those associated with several mountain habitats. These include the pinyon-juniper-oak woodland of the ridges and hills, and the cypress-pine-oak woodlands (Wauer 1996) of Boot Canyon and it's tributaries, and moist, shaded north-facing slopes on the area's north side.

Examples of nesting bird species using these habitats include screech-owl, Acorn Woodpecker, Mexican Jay, tufted titmouse, rufous sided and canyon towhees, and rufous-crowned sparrow, among others (Wauer 1996).

Amphibians are those adapted to cooler temperatures at high elevations, temporary water sources and predominant rocky substrates. These include the canyon tree frog, found breeding at ephemeral pools in Boot Canyon, and migrating up-slope into the area, and the spotted chirping frog, that lives in fractured rock and talus slopes.

Factors related to elevation also limits reptile diversity. Snakes such as striped whipsnake, bullsnake, mountain patch-nosed snake, blackhood snake, and rock and black-tailed rattlesnakes occur here. Crevice spiny, rusty-rumped whiptail, and Texas alligator lizards, and the short-lined skink find suitable habitat in the high-elevation mountains and canyons.

Common mammals of the South Rim area include gray fox, black bear, ringtail, striped skunk, spotted skunk, bobcat, mountain lion, Carmen mountain white-tailed deer, and rock squirrel. Among several rodent species of the area, yellow-nosed cotton rats inhabit high elevation grasslands.

III.D.3.1.2 Sensitive Animal Species

No federally endangered or threatened wildlife species breed or concentrate in the burn area. Two species use nearby areas.

Endangered black-capped vireos breed and nest in brushy drainages and lower slopes of the Chisos Mountains. General characteristics of breeding habitat are shrubby growth of a forest-grassland ecotone (U.S. Fish and Wildlife Service 1991). The black-capped vireo habitat nearest the South Rim burn area is the Juniper Canyon drainage below Juniper Spring , between 4000' and 4800' elevations (Peck and Barlow 2000). This site begins 2600 feet lower in elevation, downslope from the north and northeast edge of the burn area.

The only known roosting site of endangered Mexican long-nosed bats in the United States is a cave in the Chisos Mountains approximately 1.25 km from the burn area perimeter. The migratory bats summer in the area, feeding exclusively on nectar of blooming century-plant agaves. The agaves are distributed across the Chisos Mountains above 3500', including the burn area.

Texas state-listed species occurring in or frequenting the area include black bear and peregrine falcon.

The diverse woodlands of the burn area are among the park's highest-value cover and forage habitat for black bears. Park observation records and preliminary research indicate bears frequent Boot Canyon and its tributaries during much of the year. One den site is known to be used from January through April within the burn area (Mitchell 2000), and others may be present.

At least 3 breeding pairs of peregrine falcons annually use eyrie sites in the Chisos Mountains. The South Rim eyrie is consistently located on the cliff face at the southeast edge of the burn area, and the birds seek prey over all areas of the Chisos Mountains and surrounding foothills.

III.D.3.2 Comanche Draw Unit

III.D.3.2.1 Native Animal Species

Medium to large mammals making use of the desert habitat include coyote, gray fox, skunks, mountain lion, bobcat, javelina, and mule deer. Rabbits include desert cottontail and black-tailed jackrabbit. The spotted ground squirrel can be expected in the area, as well as a variety of rodent species, most commonly Merriam's kangaroo rat, hispid cotton rat; cactus, white-footed, and deer mice. While no permanent water sources serve to attract them, bats can be found foraging over the area. Most common are the western pipistrelle, brazilian freetail, and pallid bats (Jones et al. 1996).

Species associated with shrub desert and arroyo vegetative associations are found here. Species are diverse if not in high density, and are those adapted to either seasonal use or, if permanent residents, annual cycles of high temperature and low water availability.

Bird species are typified by the verdin, cactus wren, mockingbird, scaled quail, roadrunner, and black-chinned sparrow, and soaring species such as red-tailed hawk, northern harrier, black vulture and turkey vulture (Wauer 1996).

Amphibians are limited to those capable of long periods of dormancy when surface water is unavailable. Most abundant are Couch's spadefoot and red-spotted, western green, Texas, and Great-plains narrowmouth toads (Scudday 1996).

Reptiles are the most abundant of terrestrial vertebrates, including primarily Southwestern earless, marbled whiptail, and rusty-rumped whiptail lizards, and numerous snake species, with western diamondback, mojave, and black-tailed rattlesnakes, whipsnakes, and the coachwhip among the most abundant. Yellow mud turtles may be found using ponded water following rains (Scudday 1996).

III.D.3.2.2 Sensitive animal species

No federally listed threatened or endangered species use the proposed burn area for breeding, nor do they frequent the habitat.

Texas state-listed species that may breed in or frequent the area are limited to the loggerhead shrike, and the Texas horned lizard found sparsely distributed in similar habitat.

III.D.3.3 RGV Wetland-Gambusia Unit

III.D.3.3.1 Native Wildlife

Bird species associated with Rio Grande riparian and wetland habitats are found here. Nearby natural warm springs produce Big Bend's most extensive natural pond and wetland system, and associated flora and fauna. These highly productive habitats support numerous species at higher densities than most other park habitats.

Of the 445 bird species recorded in the park, 190 (43%) are neotropical migrants, species that spend the northern winter in tropical areas south of North America then return in the spring and summer for breeding. Spring migration in Big Bend National Park begins in February, increasing in pace and diversity of species through March, then reaching a peak in late April and early May. The Rio Grande Village area is an important stop-over for these long-distance migrants, providing ample cover, food, and water. For some of these migrants, Big Bend National Park is the destination point where they will attempt nesting.

Neotropical migrant species that may utilize the burn area (or adjacent areas) for nesting include gray hawk, common black-hawk, lesser nighthawk, black-chinned hummingbird, ash-throated flycatcher, Bell's vireo, Lucy's warbler, yellow-breasted chat, summer tanager, blue grosbeak, painted bunting, and Scott's oriole.

Resident nesting species that may utilize the proposed burn area include scaled quail, white-winged and Inca dove, greater roadrunner, ladder-backed woodpecker, black and Say's phoebe, vermilion flycatcher, verdin, cactus and rock wren, black-tailed gnatcatcher, northern mockingbird, curve-billed and crissal thrasher, canyon towhee, black-throated sparrow, northern cardinal, pyrrhuloxia , and house finch.

None of the resident nesting species are federally listed as endangered, threatened, or a species of concern (SOC). Gray hawk is federally listed as a species of concern. The *pusillus* race of Bell's vireo is listed as endangered, but is found only on the west coast, not in Big Bend National Park.

Year-round resident birds generally nest earlier than migrant species, usually from April through June, although some will begin nesting in March (scaled quail, white-winged and Inca dove, greater roadrunner, black and Say's

phoebe, vermilion flycatcher, cactus wren). Neotropical migrant species that nest in the park generally begin nesting in late April or early May.

Conducting the burn after mid August will minimize the number of active nests destroyed or disturbed by fire and burn-related activity and also minimize disturbances to courtship. It will also avoid most of the migrants moving through Big Bend and on to points south.

Native amphibians include primarily those adapted to permanent water sources of the Rio Grande and area ponds and wetlands. Most abundant is the Rio Grande leopard frog, while red-spotted toads are a distant second. Couch's spadefoot, Texas toad, and Great Plains narrowmouth toads are occasionally found.

Abundant habitat diversity and production of insects, small mammals, fishes and invertebrates in the riparian and wetland habitat of the area result in a wide variety of reptiles. Lizards common to the area include the Southwestern earless, desert spiny, canyon, side-blotched, checkered, and marbled whiptail. Native turtle species associated with the ponds and adjacent Rio Grande include yellow mud turtle, Big Bend slider, and the spiny softshell. Common snakes include many that are abundant in much of the park, including the coachwhip, bullsnake, diamondback and black-tailed rattlesnakes, and several that due to local aquatic habitats, are locally common. These include the blotched water snake, ringneck snake, and checkered garter snake.

Mammals of the area also reflect the diversity of productive local habitats. Javelina are in great abundance. Common are striped and hog-nosed skunk, black-tailed jackrabbit and desert cottontail. Mule deer occasion the area, and the spotted skunk and ring-tail are rarely seen residents. An abundance of rodents, including yellow-faced pocket gopher, kangaroo rats, and the desert pocket mouse, among others, use the sandy soils, brushy and grassy habitats along the river. An abundant prey base supports and concentrates predacious bobcat, coyote, and gray fox, along with occasional mountain lions. Spring-fed streams and the Rio Grande combine to support beaver, which have created the park's only beaver pond.

III.D.3.3.2 Exotic animal species

Mediterranean geckos have become more abundant in recent decades since discovery in the early 1970's (Wauer 1979), as has the green anole. Elegant sliders have continued their invasion into habitat of the native Rio Grande slider, and were discovered in the Rio Grande Village beaver pond in 1998. The most significant apparent impact from an exotic animal is the result of nutria invasion, and their subsequent damage to virtually all aquatic herbaceous vegetation.

III.D.3.3.3 Sensitive animal species

The Big Bend gambusia, a federally listed endangered species is found nowhere else other than ponds in the area, near proposed burn blocks 1 and 2 (Figure 4). An artificial pond, constructed in 1966, serves as a refuge for the species, and is designed to prevent other fish species from entering. Water for the pond is pumped from a concrete spring box containing the outflow of Spring 1. A separate population is maintained in the Spring 4 pond located about a one quarter of a mile from the burn unit. Annual sampling indicates a very small number of Big Bend gambusia persists in the Rio Grande Village Beaver Pond.

Among state-listed species, only the common black-hawk is known to nest nearby. During recent years, a mated pair of black hawks have nested approximately ¾ mile west of the proposed burn area. State threatened fishes that may be found in the Rio Grande adjacent to burn block 5 include Mexican stoneroller, Rio Grande shiner, and Chihuahua shiner.

III.D.3.4 Tamarisk Piles Unit

Burn piles are all located within the Rio Grande Village area and adjacent floodplain, thus the wildlife description (above) for the Gambusia Pond burn generally applies. However, tamarisk burn piles occupy specific sites within the Rio Grande Village floodplain that are generally barren of other vegetation.

Although the burn piles have not existed more than a few years, there is potential for some colonization or temporary use of the piles by a variety of wildlife species seeking shelter, nesting, or feeding habitat. Species expected to occupy the piles include reptiles and small mammals such as rodents. No state or federally listed species are known to depend upon the tamarisk piles for habitat.

III.D.3.4.1 Impacts of the Preferred Alternative for all sites

III.D.3.4.1.1 Animal Communities

The riparian vegetation along the Rio Grande would not be adversely impacted by the periodic burning to halt re-encroachment of brush. Allowing the acreage to respond naturally to the fire with remaining and adjacent varieties of native grasses would continue to provide erosion control and water retention for wildlife habitat. More importantly, the native grasses would provide a permanent and broader diversity of forage ground cover for

wildlife. Many introduced grasses are too thick for many species of wildlife, especially the young, the native grasses would provide better nesting, escape, and protective cover.

Wildlife typically observed at Big Bend National Park include mule deer, white-tailed deer, javelina, raccoons, bears, coyotes, gophers, skunks, owls, rattle snakes, scaled quails, great blue herons, ducks, and migratory birds. During the prescribed fire there would be a temporary disturbance and displacement of wildlife. Wildlife would be expected to reoccupy the acreage following recovery of vegetation. The treated acreage would continue to provide abundant nesting cover, escape cover, protective cover, and edge effects, as well as bugging and loafing areas. Some small animals may be killed or forced to relocate to areas outside the project area, but this would not be expected to have any long-term adverse effect upon local populations.

III.D.3.4.1.2 Animal Species of Special Concern (Rare, Threatened & Endangered)

According to the U.S. Fish and Wildlife Service and the Texas Natural Resources Conservation Commission, several federally listed threatened and endangered species and species of special concern occur in Big Bend National Park: Black-capped vireo (*Vireo atricapillus*), Loggerhead shrike (*Lanius ludovicianus*), Northern gray hawk (*Buteo nitidus maximus*), Texas horned lizard (*Phrynosomia cornutum)* Least tern (*Sterna antillarum*), and the Bald eagle (*Haliaeetus leucocephalus*). None of these bird species have been observed feeding, roosting, or nesting in or near the project areas, and none of the other aforementioned species have been observed in or near the project areas. Any temporary displacement of their potential habitat during the prescribed fire, however, would be very limited and would not have a discernible effect upon their populations, due to the presence of suitable habitat adjacent to the project area.

III.D.3.4.1.3 Cumulative Effects

Because the effects of all prescribed burns on animal species will be short-term and are expected to fully recover, no or limited cumulative effects are anticipated.

III.D.3.4.1.4 Conclusion:

Short-term effects upon species of special concern would be negligible. A fire-influenced vegetation composition of the project area could attract such species to the park, which would be beneficial to the species in the long-term. Any short-term, minor impacts to wildlife populations would be offset by the long-term benefits associated with vegetation changes due to fire effects. Thus there would be no impairment to wildlife resources from the preferred alternative.

III.D.3.4.2 Impacts of Alternative A

III.D.3.4.2.1 Impact Analysis

Continuation of current management, Alternative A, would have no immediate effect on animal populations, at the Southeast Rim, Comanche Draw and Tamarisk Piles Units. Continuing current management direction at the RGV Wetland-Gambusia site would not allow the endangered fish to occupy the full range of its potential habitat thus not reducing the population's vulnerability to disturbance, which could adversely impact the species.

III.D.3.4.2.2 Cumulative Effects

Cumulative effects of continuing current management are not anticipated for the Comanche Draw and the Tamarisk Piles Units due to the nature of the vegetation at the sites and the amount of additional available habitat. For the Southeast Rim, cumulative effects could arise if an extreme fire event resulted in the alteration of habitat. This could adversely impact animal populations dependant on some special habitat element on the Southeast Rim that was limited in availability and not found elsewhere in the Chisos or the surrounding landscape. For the RGV Wetland–Gambusia site continued current management may continue to contribute to habitat degradation for the endangered species that may further imperial the species. Such impacts at the Southeast Rim and RGV Wetland-Gambusia sites could be adverse direct local and of long duration.

III.D.3.4.2.3 Conclusions

Continuing current management would not result in impairment of wildlife resources at Comanche Draw and the Tamarisk Piles Units. Adverse impacts could occur due to cumulative effects at the Southeast Rim and RGV Wetland-Gambusia Units. In the case of the Southeast Rim, wildlife populations could recover in time, as the habitat recovers thus not impair the resource. In the case of the RGV Wetland, impairment of wildlife resources could occur if the endangered fish species was lost due to a high degree of disturbance to its existing habitat. The resiliency of the species to recover from such a disturbance, however is unknown.

III.E Soil and Water Resources

III.E.1 Methods

This section describes the environmental consequences on soil and water resources associated with the preferred action, Alternative B, and the no action alternative, Alternative A. This section presents the regulations and policy for management, and then describes the effected environment for each unit, followed by the impact analysis, cumulative effects, and conclusions for the preferred action alternative, and the no action alternative. This analysis is then repeated for each unit.

The analysis includes a brief description of the affected environment and an evaluation of effects. The impact analysis involved the following steps:

- Identify the area that would be impacted.
- Compare the area of potential impact with the resources that are present.
- Identify the intensity, context, duration (short- or long-term), and type (direct or indirect) of effect, both as a result of this action and from a cumulative effects perspective. Identify whether effects would be beneficial or adverse. The criteria used to define the intensity of impacts associated with the analyses are presented in Table 5.
- Identify mitigation measures that may be employed to offset potential adverse impacts.

The impact analyses were based on professional judgment using information provided by park staff, relevant references and technical literature, and subject matter experts.

III.E.2 Regulations and Policy

Soil and Water Quality: (Water Quality, Wetlands, and Floodplains): National Park Service policies require protection of water quality consistent with the Clean Water Act. Special consideration of impacts on floodplains and wetlands is also required by Executive Orders 11988 (*Floodplain Management*) and 11990 (*Protection of Wetlands*). NPS guidelines (*Floodplain Management and Wetland Protection Guidelines*, Federal Register, Vol. 45, #104, 35916-35922, May 28, 1980; *National Park Service Floodplain Management Guidelines* (Special Directive 93-4), 1993; and Director's Order #77-1: Wetland Protection, 1998) provide procedures for implementing these orders. Water quality may be affected by increases in nutrients. Fire may also increase soil erosion, both immediately after a fire event when storm patterns bring intense rainfall into the area and over several years due to a decrease in vegetative cover. National Park Service policies and Special Directive 91-6 require the consideration of impacts on soils.

Cumulative Impacts: The Council on Environmental Quality (CEQ) regulations, which implement the NEPA act, requires assessment of cumulative impacts in the decision-making process for federal projects. Cumulative impacts are defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions" (40 CFR 1508.7). Cumulative impacts are considered for both the no-action and proposed action alternatives.

III.E.3 Effected Environment

III.E.3.1 Southeast Rim

Puerta Madrone soils cover this burn area. These soils are gravelly and cobbly soils formed over either igneous or shale bedrock, depth ranges from very shallow to moderately deep (USDA 1985). Soils are well drained with moderate to rapid surface runoff. Bedrock outcrops and talus slopes can also be found in the area. Soils tend to be shallow on the steep slopes within the fire area, however, soil depth increases towards the bottom of the slopes.

Two headwater tributaries originate in the fire area, both stream channels flow into Boot Canyon, then into Juniper Canyon, which drains a major portion of the east side of the Chisos Mountains. All of these streams flow in response to rainstorms, as is typical for desert streams. The stream channels within the burn area are formed primarily of bedrock, with scattered accumulations of large boulders. Many small pools, or tinajas are formed from water eroding depressions in the bedrock. These depressions vary in size and depth and may hold water for months after a large rainstorm. Boot Canyon downstream of the proposed burn has a boulder and cobble channel. No springs occur within the proposed fire perimeter, however Upper Boot Spring is adjacent to the west side of the proposed burn perimeter and Boot Spring is downslope of the northern edge of the proposed burn.

Boot Spring flows for part of the year, primarily after the rainy season. Many backpackers use this spring as it is the only water source in the High Chisos.

III.E.3.1.1 Impacts of the Preferred Alternative

III.E.3.1.1.1 Impact Analysis

Nutrient Increases: Nitrates and phosphates will increase immediately after a fire, in the soil and downgradient in Boot Spring. Short term increases will likely cause aquatic algae and moss to green up. Higher levels of these nutrients will persist for several years, as would occur under a natural wildfire event.

Effects of Human Waste: If the fire crews are scattered throughout the area, and human waste is buried according to park policy, there should be no effect on water quality from this source. The two available composting toilets would handle a small fraction of the human waste generated by a group of 100 firefighters.

Soil Erosion: All of the locations where handlines may be constructed are in very rocky soils. The erosion risk is very low in these areas and the hand lines would be rehabilitated after the fire. Fires can increase soil erosion due to removing vegetation and duff. A low intensity burn that only burns grass and smaller vegetation and burns only small patches of duff has a very low risk of causing increased soil erosion, especially on gentle slopes. The steepness of the slope and the continuity of burn mosaic are the primary factors in determining the amount of potential soil erosion. Layers in the soil which repel water (soil hydrophobicity) also can increase erosion dramatically. The continuity of the burned mosaic influences the area of hillslope upon which erosion can potentially occur. An spatially extensive high-intensity-burned area will produce considerably more material that an area that has been spottily burned by a low intensity fire.

The highest risk areas for erosion in the proposed burn area are on the steep slopes. Of these areas, the highest risk areas are the steep north and northeast facing slopes, which tend to have more mesic environments that have a higher density of vegetation. The steepness of the slope, combined with the relatively heavier fuel loads, has the greatest potential for an intense burn under certain weather/fuel conditions. The potential for hydrophobic soil effects is greater too, due to the scrub vegetation on this slope. An intense burn on this slope would result in severe erosion. Without duff and leaf litter cover, rainstorms would wash soils down the slope, and create shallow gullies down to bedrock. The soils are shallow in this area, and losing soils on these steep slopes would decrease the probability of regeneration of woody species.

Soil Sterilization: The top of the rim would have a much lower potential for erosion due to the gentle slope and lack of shrub vegetation. Intense fires burning in areas with high fuel levels can generate sufficient heat to sterilize the soil. Rocks in the surface of the soil conduct heat and can intensify the heating of the soil. High soil temperatures can kill the soil microbes, seed bank and grass root clumps that are necessary to revegetate the area. Soil sterilization is also a natural process in some areas depending upon the local fire ecology. Intense wildfires that sterilize the soil are thought to be the only natural control for root rot and other forest fungal diseases common in more mesic environments. Under prescribed conditions, no soil sterilization would occur due to the planned low intensity of the burn.

Soil Hydrophobicity: This condition occurs when a layer in the soil repels water, causing rainstorms to generate large amounts of surface runoff and often severe erosion. The potential for development of hydrophobic conditions is higher for coarse-textured soils and under scrub-type vegetation. The soils found in the proposed fire are coarse gravelly or cobbly loams (USDA 1985) and probably would be subject to hydrophobic conditions. There have been no local studies on this condition for the vegetation communities found in the Chisos Mountains, however there was a study further to the east on the Edwards Plateau. This study burned oak and juniper sites, after trees and brush had been cut down. Infiltration rates were reduced significantly on the oak sites, due to hydrophobic effects (Hester et al. 1997). Infiltration on the juniper sites were reduced, but still remained high. Soils having shrubs with waxy leaf coats or high essential oil content seem to be susceptible to water repellency (DeBano 1981).

Boot Spring: Boot Spring may see a slight increase in springflow due to the reduction of evapotranspiration resulting from the reduction in vegetative cover. This increase would only be observed during wet years, as during droughts, the existing vegetation would use all available soil water.

III.E.3.1.1.2 Cumulative Effects

There will be no cumulative effects from the preferred alternative to soil and water resources. Any effects are believed to diminish in time as vegetation recovers and thus reduce erosion and runoff. Soil sterilization and hydrophobicity will be highly localized and in very small discrete patches. Increased flow in Boot Spring will be relatively small due to the relatively small treatment area, (343 acres; with respect to watersheds) and may be offset as vegetation recovers.

III.E.3.1.1.3 Conclusions

Under the mild to moderate conditions of the prescribed burn for the Southeast Rim site, adverse impacts to soil and water resources are expected to be negligible to minor, direct, local in extent and short-term. No impairment will occur to these resources.

III.E.3.1.2 Impacts of Alternative A

III.E.3.1.2.1 Impact Analysis

No immediate impacts are expected to occur to soil and water resources with the current management direction, the no Action Alternative.

III.E.3.1.2.2 Cumulative Effects

Cumulative effects of Alternative A could arise in the event of an extreme wildland fire event on the Southeast Rim. This event would be in response to the accumulation of vegetation in the absence of periodic fire. Such an event could result in high erosion rates, patches of soil hydrophobicity and soil sterilization. Water quality would be negatively impacted by sediment transported off the burned area. These effects would be short-term (less than a year and half) and decline with vegetation recovery. .

III.E.3.1.2.3 Conclusions

At most what can be expected from the no action alternative is short-term moderate effect on water quality, soil erosion and soil sterilization. These effects would dissipate with the rapid recovery of vegetation on the site, thus no impairment would occur as a result of the no action alternative, Alternative A.

III.E.3.2 Comanche Draw

The soils within this burn unit are Tornillo Loam, a deep, nearly level soil located in broad alluvial valleys, particularly in the northern portion of the park. This soil has a deep rooting depth, and is occasionally flooded during intense rainstorms. Pockets of grass are often found in this soil (USDA 1985) and historical accounts of the area indicate that grasslands were much more extensive, however pre-park grazing severely diminished the extent of the grass cover (Maxwell 1985). Tornillo Loam is also highly erosive, and areas of bare soil seal in response to raindrop impact, thereby reducing infiltration and increasing surface runoff and erosion. Currently, most of this area is bare soil, with scattered shrubs and small patches of grass. Under these conditions, many small rills are forming over this area due to the accelerated surface erosion due to lack of vegetative cover. Two to eight inches of topsoil has been lost over much of the area. Biotic soil crusts also appear to be largely absent in this unit; in other areas of this same soil type, these crusts appear to aid grass recovery by providing microhabitats for seed germination. This burn unit is surrounded by the more gravelly Upton-Nickel association which has well drained shallow soils (USDA 1985). Upton-Nickel soils tend to be more dominated by desert shrubs with less grass cover as compared to Tornillo Loam.

This burn is located along a tributary arroyo of Nine Point Draw, which flows east through Dog Canyon to Maravillas Creek. Water flows in these desert stream channels in response to local rainstorms. Stream channels are small and deeply incised, typically 1 to 2 feet wide and 0.5 to 2 deep within the burn unit. In places, the stream channel appears to have formed in the ruts of old roads through the center of this burn unit. In very flat areas, the stream channels may disappear into small shallow depressions, where rainstorm runoff may form ponds lasting several hours to several days after a rainstorm. Johnson grass, an exotic grass, are located in these depressions which historically would be covered with Tobosa grass and bluestem.

III.E.3.2.1 Impacts of the Preferred Alternative

III.E.3.2.1.1 Impact Analysis

Low intensity prescribed fire will slightly increase available soil nutrients, temporarily stimulating plant growth. An increase in grass cover may slightly reduce the rate of soil loss. Hydrology of drainages in this area will not be affected.

III.E.3.2.1.2 Cumulative Effects

With minimal direct effects from burning, cumulative effects are expected to be minimal.

III.E.3.2.1.3 Conclusions

Given the benign effects of the fire both immediate and cumulatively in the Comanche Draw Unit, impacts would be negligible and thus not impair soil and water resources.

III.E.3.2.2 Impacts of Alternative A

III.E.3.2.2.1 Impact Analysis

No impacts to soil and water resources are anticipated by the no action alternative, Alternative A. Soil erosion rates are presently near maximum due to the sparseness and patchiness of the vegetation. Water quality will also not be effected.

III.E.3.2.2.2 Cumulative Effects

With negligible immediate effect from the no action alternative, no cumulative effects would be expected.

III.E.3.2.2.3 Conclusions

Continuing on with current management would not impairment to soil and water resources would occur with the no action alternative, Alternative A, for Comanche Draw Unit.

III.E.3.3 RGV Wetland-Gambusia Unit

The burn units in this area are located on the deep, well-drained soils of the floodplain of the Rio Grande. The units are surrounded by bedrock limestone hills. The floodplain soils, Glendale Harkey association, support dense stands of trees and shrubs (USDA, 1985).

Several springs flow from lower slopes of the limestone hills in this area. One spring supplies water to the Gambusia Pond. Overflow from the pond joins other groundwater and flows down into the area of the removed road, and through burn unit # 3 into burn unit #5 (Figure 5). Another spring, which flows intermittently, is located near Berkely Cottage. This spring's drainage flows near the west boundary of burn unit #5 (Figure 5).

Over the past several years, a road located in this area was removed to restore natural wetland vegetation. Wetland trees and grasses have been transplanted on the old roadbed located around burn unit #3 and on the north side of burn unit #2.

III.E.3.3.1 Impacts of the Preferred Alternative

III.E.3.3.1.1 Impact Analysis

By removing woody vegetation, evapotranspiration will decrease. Soils will remain saturated longer after rainstorms and the water table should rise, increasing the wetland characteristics of the soil. Nitrogen and phosphorus will temporarily increase in the soil and groundwater (McDonald et al. 1991). Nutrient levels in the springs in the area would also increase over several months to several years before returning to current levels. Risk of soil erosion is negligible due to the gentle slopes and the amount of burned limbs and other organic matter that would be retained on the soil surface.

III.E.3.3.1.2 Cumulative Effects

Cumulative effects beyond the immediate effects of the treatment on soil moisture are uncertain. Little if any cumulative effects to soil nutrients will occur to increased availability of nitrogen for a short period in the springs. Aquatic plants and organisms should readjust to pretreatment levels as nutrient availability declines.

III.E.3.3.1.3 Conclusions

No impairment to soil and water resources have been identified as a result of the preferred treatment alternative in the RGV Wetland-Gambusia Unit because of the negligible treatment effects.

III.E.3.3.2 Impacts of Alternative A

III.E.3.3.2.1 Impact Analysis

The no action alternative, Alternative A, would continue to result in a shortened period of soil moisture saturation relative to its potential. Also periods when water would persist in pools at the soil surface would also be shortened. Areas would continue to be occupied by mesquite which reduce hydrologic flow and occupy space that would otherwise be available for surface ponding of water. Thus additional habitat for the endangered fish *Gambusia gaigei* would not be provided. Nutrient levels would not increase in effected springs.

III.E.3.3.2.2 Cumulative Effects

By continuing current management at the RGV Wetland-Gambusia Unit mesquite may encroach into restored fish habitat and reduce hydrologic flow that would result in decreased surface water and thus a reduction in endangered fish habitat that would further imperial the species.

III.E.3.3.2.3 Conclusions

Continuing current management would allow for continued reduction in soil moisture, decreased hydrologic flow, and decreased areas of ponding surface water and the duration of this ponding. This results in the reduction of

available habitat for the endangered fish *Gambusia gaigei* . To what extent this reduction in habitat further imperils the fish is largely unknown. Given this uncertainty, it may be necessary to consider the no action alternative as a potential impairment because of its importance in providing habitat for an endangered species.

III.E.3.4 Tamarisk Piles Unit

The piles are generally located along a canal system in the Boquillas Valley and are relatively small in size (< 15 feet in diameter). The soil these piles are located on has been disturbed in the past and is generally void of any vegetation. The piles also do not occur in a flood plain. The presence of these small piles on the landscape does not contribute significantly to over all soil environment nor the hydrologic function of the Boquillas Valley.

III.E.3.4.1 Impacts of the Preferred Alternative

III.E.3.4.1.1 Impact Analysis

Because of the barren nature of the soil where the piles are located and their small size the immediate effect of burning these piles is negligible on soil and water resources in the tamarisk piles unit.

III.E.3.4.1.2 Cumulative Effects

Cumulative effects of burning the piles will also be minimal on soil and water resources.

III.E.3.4.1.3 Conclusion

No impairment to soil and water resources are anticipated from burning tamarisk piles.

III.E.3.4.2 Impacts of Alternative A

III.E.3.4.2.1 Impact Analysis

Given the small size of the piles and the barren nature of the soil minimal impacts will occur to soil and water resources if the piles are left in place, which is the no action alternative, Alternative A.

III.E.3.4.2.2 Cumulative Impacts

No cumulative effects to soil and water resources are also expected from the no action alternative.

III.E.3.4.2.3 Conclusion

The no action alternative, to leave tamarisk piles in place, will not impair soil and water resources in the tamarisk piles unit.

IV CONSULTATION and COORDINATION

Persons, organizations, and agencies contacted for information, or that assisted in identifying important issues, developing alternatives, or analyzing impacts include:

Federal
U.S. Department of Agriculture - Natural Resources Conservation Service
U.S. Department of the Interior - Fish and Wildlife Service
Frank J. Deckert, Superintendent, Big Bend National Park
Chris Turk, Regional Environmental Quality Officer, National Park Service - Intermountain Support Office, Denver

State
Texas Natural Resources Conservation Commission
Texas Parks and Wildlife Department, Wildlife Diversity Program
Texas State Historic Preservation Office

Other
Desert Botanical Garden, Phoenix, AZ
The Nature Conservancy of Texas

Prepared by
Fire Management Staff – Big Bend National Park, Texas
Science and Resource Management Staff – Big Bend National Park, Texas

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VI List of Recipients